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RECENT EXPLORATION IN PERU.*

By Enos Brown.

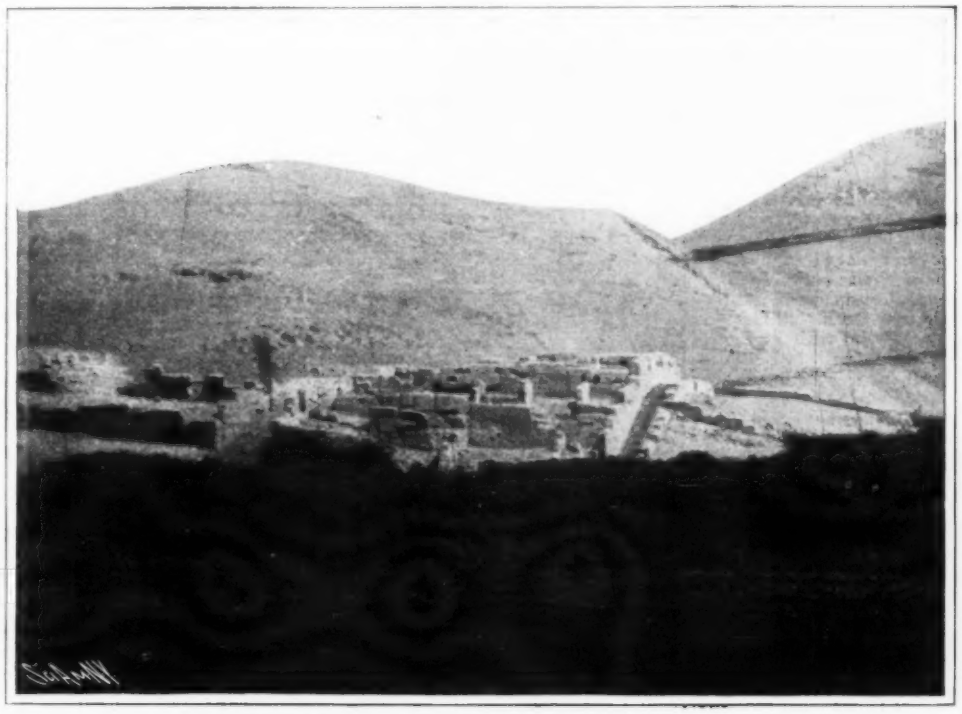
The University of California has recently acquired one of the largest and most valuable collections of Peruvian antiquities possessed by any institution in the United States. Though surpassed in the number of objects by the collection at Berlin, in comprehensiveness, intrinsic value, and the assistance which it gives archeologists to determine the civilization, manners, habits, and customs of the early races inhabiting the coastal region of Peru prior to the rise of the Inca dynasty, the collection of the California University is unsurpassed.

This valuable archeological data is the result of researches prosecuted by Dr. Max Uhle, as representing the university, at the instance of Mrs. Phœbe A. Hearst, regent, who defrayed all the expenses of the expedition. The explorations were begun in 1901, and conducted in Huamachuco and Trujillo in the Department of De Libertad, Chincha Alta, Chincha Baja, Department of Huancanelica, and Pisco, Huaitara, Ica and Rio de Ica, in the Department of Ica. All these localities are near the coast, between the parallels of 8 deg. and 13 deg. south. Dr. Uhle laid bare the great structures at Pachacamac, Chancan, Huaca del Sol, and many other places, besides excavating altogether hundreds of graves and bringing to light a vast number of objects illustrating the manners of a primitive age. In an effort to determine somewhat of the chronological period to which most of the objects were to be attributed, Dr. Uhle advances a theory which may or may not be accepted by archeologists, the conclusions of the scientist being that at least twenty-five hundred years before the rise of the Incas, Peru was inhabited by a highly-civilized race, to whom is to be attributed the fabrication of the most artistic of all the objects secured during his excavations. Assuming the Inca period to begin at 1062 A. D., this would fix the chronology of the objects as early as 1,500 years before the Christian era. The theory of Dr. Uhle, while highly interesting, remains to be established by later explorations. As yet no traces of a race existing prior to the date assigned have been discovered. Peru is a vast country, and the area explored up to the present time is comparatively limited. The future may disclose the secret. The conclusion, however, is admissible that about 1500 B. C. a strong and enterprising people did invade the country from the north, and established themselves by conquest or discovery, introducing there manners, customs, laws, and the arts—a race which, twenty-five centuries after, were overthrown by the Incas and incorporated into the later dynasty. Henceforth the identity of the primitive nation is absorbed in that of their conquerors.

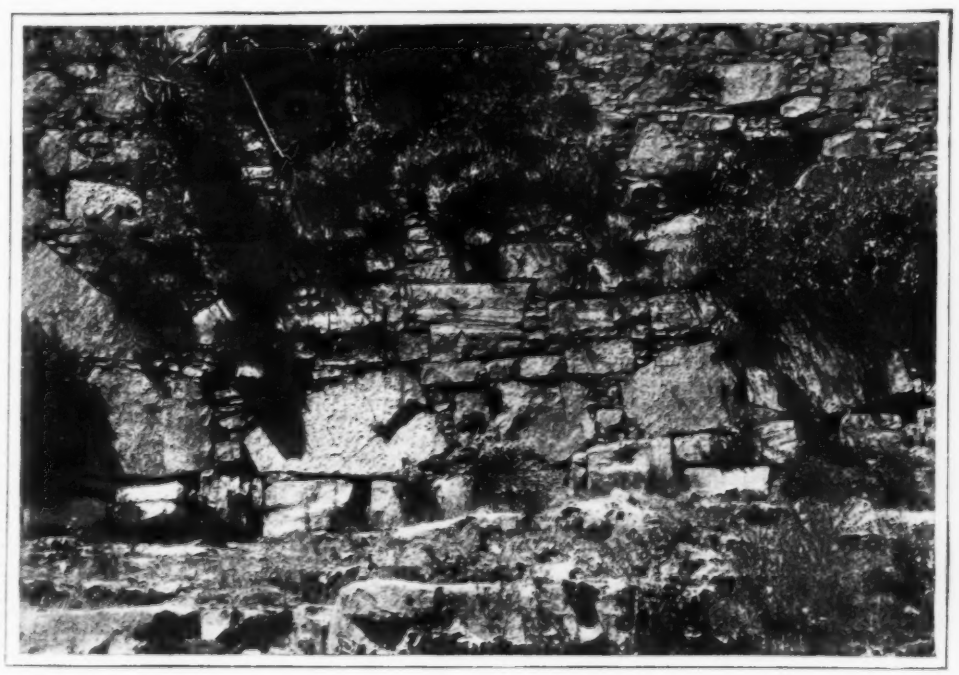
The recent explorations of Dr. Uhle have been conducted with the care of the learned archeologist and with a thoroughness only possible when liberal supplies of money are forthcoming.

Temples, fortresses, and shrines have yielded many secrets, and their fine proportions and, in many instances, beautifully carved façades, attested the architectural ability of the builders and the skill of the sculptors, who displayed the highest talent in adornment. The walls of the temples are massively constructed and of cyclopean proportions. The stones are fitted to their positions with admirable skill, and in no case has mortar been employed, yet they retain their original positions, and to the present have bid defiance to the assaults of time. The era to which the construction of these wonderful edifices may be assigned can only be conjectured.

It is on the graves of the dead that the archeologist turns for whatever knowledge of the ancient races of Peru the world possesses. These receptacles yield certain information of the high stage of civilization to which they aspired. The ruins could have been built by no race without a definite knowledge of architecture and building construction. They domesticated the llama and alpaca, using the fleece for fabrication into clothing and blankets. In the plastic arts they excelled. Many centuries must have elapsed before the natives of the Andes could have produced cultivated varieties of maize and potatoes. Considerable progress is attested



RIGHT-HAND END OF PANORAMA OF HUACHA TAMBUINGA.



CONSTRUCTION OF THE SOUTHWESTERN FORTRESS WALL FROM THE SOUTH, HUAMACHUCO.

EASTERN PILLAR OF THE GRAND GATEWAY, HUAMACHUCO.

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* Specially prepared for the Scientific American Supplement.

in metallurgic, ceramic, and textile arts. In the numerous utensils fashioned from clay, instances are found of attempts at portraiture. Gold, silver, and copper ornaments of decorative and personal adornment are found, and indicate considerable progress and refinement in their manufacture and design. Cotton cloths, woven in complicated colors and graceful patterns, prove a high degree of skill in the fabrication of textiles. The painted vases and pottery are proofs of considerable talent, while the many articles of utility used in the household witness to the great ingenuity and invention of the people. Battles between the Peruvians and their enemies are depicted upon some of the larger specimens of pottery, with representations of the weapons in use, and are executed with much power and graphic delineation. A system of enumeration and accounting by means of variously colored threads was invented, and they were familiar with the curative properties of plants.

The dead were mummified by burial in a soil impregnated with chemicals or preserved by the intense dryness of a region where rain never falls. It is not believed that the preservation of the body after death was designed, but the custom of interring in the graves the most valued possessions of the dead seems to have been universal. It is to this custom that the archeologist is able to declare with some degree of certainty the standard of civilization attained at different periods, together with the probable time at which interments were made. In all the excavations of Dr. Uhle, the classification of the different cultures was observed. Several layers appear to have been superimposed, each with essential differences. In his opinion, formed after observation of numberless instances and at separate stations, the lowest and earliest of the layers exhibited a higher degree of artistic skill in the fabrication of the objects exposed than the one just above, and so on until the last, or fifth, which exhibited a great deterioration over all its predecessors. Five cultures were thus superimposed, and Dr. Uhle's conclusion is that each represented a definite period of five hundred years. Thus Schliemann at Troy and archeologists in many other instances were enabled to identify dynasties, and to trace periods and catastrophes in ancient localities; even in the absence of historical data.

The differences in the stratifications referred to have been noticed by other explorers in the same regions, who ascribed the changed conditions to the work of widely separated tribes, some exhibiting superiority over others.

This theory of Dr. Uhle, if well founded, proves that no account of the succession of time, as suggested in the stylistic strata, had been thought of. Dr. Uhle is the first, probably, to advance the proposition that each stratum, or culture, represents a definite period, which he conjectures to be five hundred years, the total being twenty-five hundred years for the five cultures. As no traces of former inhabitants have been found, and as it would appear impossible for the original race to have at once developed so high a stage of civilization without having left some indications of graduated progress, the conclusion is irresistible that the first culture represents an invasion of a powerful and well-developed people, somewhere about 1,500 years before the Christian era. In commenting upon this feature of Peruvian history, Dr. Uhle remarks: "It will now be easier to give the correct chronological position to each new Peruvian culture which may be discovered. Moreover, the results are of importance in investigating the connection between the cultures of Central and South America, for it is not improbable that if connection existed between the north and south, it took place during the earliest period. As the Peruvian cultures are now being classified according to age, it would be important to know by similar means the relative ages of Central America and other South American cultures; for connection can have existed only between contemporaneous cultures, and only such, therefore, should be compared if fruitful results are to be expected."

The explorations are now being conducted at Cuzco.

LODGEPOLE PINE.

THE lodgepole pine, which is known in the Sierras of California as tamarack pine, and in Colorado and Montana is sometimes called white pine, jack pine, pinyon, and scrub pine, bears the common name of "lodgepole" from the fact that the Indians used its long slender trunks as supports for their wigwams or lodges. Its geographical range is along the Rocky Mountains from Alaska to New Mexico and westward to the Pacific coast. In the United States it is found in merchantable quantity and dimensions on the spurs and eastern slopes of the Rocky Mountains throughout southern Montana, Wyoming, and Colorado, in the Bitter Root Mountains of Idaho, the Uintah Range in Utah, and in the Big Horn Mountains of Wyoming. The Bureau of Forestry is studying the species throughout this range of its best commercial distribution.

Lodgepole pine grows at all altitudes between 3,000 and 10,500 feet above sea level. In the Gallatin Mountains of Montana, and in the mountainous country south and east of Yellowstone Park it reaches its largest size at elevations between 4,500 and 8,000 feet. In Colorado, however, toward the southern limit of its range, the conditions which are necessary to its best growth are found between 9,000 and 10,500 feet elevation.

Lodgepole pine is valuable, for one reason, because it grows on high mountain slopes, and also on old "burns," where other trees find difficulty in obtaining a foothold. It readily adapts itself to most diverse soil conditions, but thrives best where there is considerable moisture. Its roots accommodate themselves to the shallow soil common in the localities where it grows. At a very early age this tree produces cones in large quantities, and after it is ten years old the seed are generally fertile. The cones sometimes open and distribute the seeds as soon as they are ripe, though more commonly they remain on the trees for years with their seed carefully preserved beneath the scales. In many cases squirrels cut off the closed cones and hide them away in the ground. If a fire occurs before the seeds are eaten, it will cause the cones to open and set them free. As a rule, however, the cones of many seasons remain on the trees until a fire comes along, and, by heating them, liberates the seeds, when a dense growth of seedlings follows.

In many localities where lodgepole pine now grows, the ground was originally covered with Engelmann spruce in mixture with red fir and other species. Repeated fires laid waste these forests, and prevented their reproduction by destroying the seed and the thick forest floor of decaying leaves and litter, which is absolutely essential for the seed germination of these species. Lodgepole pine, however, thrives on an impoverished soil, and its great seeding capacity and the ability of the cones to withstand fire cause it to spread quickly over burned areas. In places where the pine has carpeted the ground again with a quantity of forest litter, and where lumbering has thinned the forest sufficiently for the light requirements of Engelmann spruce and red fir, these more valuable trees are found taking the place of lodgepole pine. Thus if fires can be kept out of the woods of this region, these more important trees can be produced in many places where they are now virtually extinct.

The wood of lodgepole pine is light yellow to nearly white in color, with a coarse but straight grain. It is more resinous than the eastern white pine, but less so than the yellow pines of the South. It is soft and easily worked, and would make excellent finishing lumber were it not for the abundance of small though hard knots, and for its tendency to warp and check with seasoning. Without doubt the best use of lodgepole pine at present, and the one to which it is most largely put, is for railroad ties and mine props; but to be utilized with the greatest profit for these purposes the timber must first be subjected to preservative treatment. The Bureau of Forestry has for some time been conducting, in Montana and Wyoming, exhaustive tests in seasoning and in preservative treatment of this pine, and a comprehensive bulletin on the subject is now in preparation.

During the season of 1903-4 between 1,300,000 and 1,400,000 lodgepole ties were cut, most of which were treated with preservatives. The cut of this season will exceed this number, and without doubt the use of lodgepole pine for ties will increase yearly. Trees between 11 and 14½ inches in diameter breasthigh are hewed; those larger are logged and sawed, as the hewers refuse to work them. When a tree reaches 11 inches in diameter it is mature for ties; this makes it possible to remove a quantity of material from the dense natural forests as soon as a number of the trees have reached that size, and thereby to stimulate the smaller ones to a more active growth. At the same time a new generation may be started in the openings from the seed of the felled trees.

Great quantities of lodgepole pine are also used for props in the numerous mines of the region where this tree grows. The timber is cheap, and in its natural condition answers for temporary purposes in mine development; when well seasoned or treated with preservatives it may be used for permanent construction. Miners use poles as small as 5 inches in diameter at the top, and this demand for small timber works another advantage to the forest in that it offers a means of utilizing the upper parts of trees cut for lumber, which in the ordinary way of logging are left on the ground to become dry and increase the danger of fire. It also makes possible the thinning of pole stands which contain few or no trees large enough for ties, but which are so dense that the trees have almost stopped growing.

By far the larger part of the merchantable lodgepole area is within existing or proposed Federal forest reserves, where the lumbering regulations which the government put into effect some time ago will protect and benefit the forests.

Other objects of the Bureau of Forestry in this study are to ascertain the rate of growth of the tree, and how it may be increased; to better existing lumbering regulations; to devise a system of fire protection; and to extend the commercial uses of the wood. A controlling consideration is the need of maintaining the forests on all the mountains they now cover, and of causing them to spread more widely, if possible, since the most important function they can perform is to safeguard the watersheds they include. This study will enable the Bureau to carry out more effectively the work of forest reserve management lately intrusted to it by Congress. The results of the study should also prove of large value to railroads and private owners, who hold a great many odd sections of land all through the lodgepole pine region.

RECEPTACLES OF QUARTZ AND THEIR USES IN CHEMISTRY.

By M. BERTHELOT.

FOR some time past we find in commerce a variety of recipients or tubes of a new material known as fused quartz, and these are distinguished by special qualities, such as their infusibility at temperatures as high as 1,400 degrees C., their resistance to acids, as well as sudden cooling, etc. I recently undertook some experiments with this material analogous to those which I made upon glass vessels and tubes sealed by the blowpipe. The latter were designed to be used for different researches, notably those relating to slow reactions carried out at constant temperatures and under pressures as high as 200 atmospheres. But the applications of this method are limited by the temperature of softening and fusion of the glass, and I could scarcely work higher than 550 degrees C.

By the use of vessels made of fused silica, it is possible to reach temperatures as high as 1,500 degrees. Some precautions must, however, be taken with the use of such vessels, and it seems useful to make some general observations in this case, before describing some of the new experiments made in my laboratory and the new problem I attempted to solve by their use.

The quartz tubes of small size may be worked by the oxyhydrogen blowpipe or more easily by the oxygen-acetylene blowpipe, which gives much higher temperatures. They can be drawn out or welded like glass tubes, but care must be taken against the cooling, which is quicker. The tubes which I generally employed are those of 10 millimeters (0.4 inch) diameter, some 100 millimeters (4 inches) long. Their capacity after sealing varies between 4 and 5 cubic centimeters. The thickness, which is about uniform, is some 0.7 millimeter. The resistance to internal pressure is near 3 atmospheres and this lasts up to the commencement of the softening point, between 1,300 and 1,400 deg. C. If need be, we introduce solid bodies in definite weight into the tube before drawing out the end. Then the latter is drawn, and can be fused to a capillary tube which is thicker and more convenient to join to a mercury pump. The mercury of the latter should never be allowed to come into the quartz tube. The pump serves to make the vacuum and then to introduce, by the

GREAT SOUTHWESTERN GATE OF FORTRESS EL CASTILLO, HUAMACHUCO.

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usual methods, different gases in a pure state, either at the ordinary temperature or under a reduced pressure at the required degree. We then seal up the capillary part by the blowpipe, in the region which belongs to the main cylinder, carefully avoiding the heating of the enlarged portions and of the gases therein contained.

As to the material introduced into the tube, the quantities of solid matter and gases are to be regulated with care, according to the limits of resistance stated above. In the case of gases which are isolated, or else used along with matter which is quite stable at 1,400 degrees C., we fill the tube when cold with the gases under a pressure of 36 or 38 centimeters of mercury at most, and often reduced to 15 centimeters. We measure this pressure exactly, along with the barometer pressure. As to solid matters which may take the gaseous state at 1,400 degrees, their weight should be established so that the united pressures of their vapor and the cold gas introduced into the tube shall not exceed 2.5 or 3 atmospheres at 1,400 degrees.

As to the method of heating, the quartz tubes are heated by the electric current according to the usual processes, by placing them in a large earthenware tube which should be unglazed. The latter is surrounded by a spiral of thin platinum foil which heats up by the current. The outer air freely penetrates into the inside of the large tube. The current is regulated by resistance. We can work as high as 25 amperes, in general, at a temperature which is determined by a Le Chatelier regulator or other exact instrument. The heat is kept constant for one or several hours. There is no advantage in continuing the heat too long, on account of the permeability of the quartz, which will be mentioned below. The quartz tube placed inside the earthenware tube is surrounded by a thin platinum foil (insulated electrically), so as to avoid sticking to the large tube. But if we exceed 1,400 degrees heat, the platinum foil is likely to adhere to the earthenware tube. Besides, the quartz tube commences to swell up under the pressure of the gas, at that temperature, and if the heat is too high the tube may burst, breaking the outer tube.

The next step is the cooling and removal of the matter in the quartz tube. When the experiment is finished, we can allow the whole apparatus to cool slowly. But it is often preferable to take out the quartz tube at once and the platinum foil surrounding it, by means of a platinum wire which has been fixed to it beforehand. The cooling can be made instantaneous by plunging the red-hot tube and the foil wrapping into a bath of distilled water. The quartz tube resists these conditions very well, and we can thus carry on some new experiments by its aid.

To collect the gases and other products we proceed as follows, first taking care to observe the tube and its contents carefully before opening it, and if need be, by the hand-glass or the microscope. The gases should be collected over mercury, then measured and analyzed. To this end we take the cold tube in the hand and hold it immersed in a large tank of mercury with the pointed end downward, and we break off the point carefully by means of cutting pliers. The mercury rises gradually in the tube, up to a certain height which depends on the original pressure and the volume of the newly-formed gases. We then turn up the tube under a small test-tube filled with mercury and by regular and prolonged shocks all the gas is made to pass into the test-tube. The quartz tube which has been filled with mercury is emptied, and we measure the mercury either as to weight or volume, so as to have the exact capacity of the tube. On the other hand, we measure the gas taken from the quartz tube, by means of small graduated tubes from 2 to 5 cubic centimeters, well divided into one-hundredths of a cubic centimeter, and giving a reading to the hundredths. Then we proceed to analyze the gases by the usual methods.

As to the solid bodies of the tube, either the original matter or bodies which are formed during the experiments, such as the diamond, the carbon separated from hydrocarbon, etc., they are taken from the tube at the time of placing in the mercury or afterward, and examined. If need be we make an experiment by heating two similar quartz tubes at the same time in the same earthenware tube, one for observing the gases and the other for the solid bodies, without bringing them in contact with the mercury.

The use of quartz tubes shows a phenomenon which complicates their applications considerably; this is their permeability. In fact, the tubes are not impenetrable by gases and vapors, on the contrary to glass vessels. This observation has already been made in the case of hydrogen by M. Villard, and by Messrs. Jacquerod and Perrot for helium, and this is the case even below a red heat. I found that it is the same, but in a less degree, for nitrogen and oxygen, and I observed the exchange which takes place between the gases formed inside the tube and the gases of the air, under certain conditions which are of interest. All the tubes mentioned below were heated in air, under the normal pressure. The gases had been introduced into the tubes by using a mercury pump, but without allowing any trace of mercury to enter the tube. The pressure of the gases is accurately known. Some of the phenomena which were observed are given as follows: 1. Amorphous carbon (wood charcoal purified by the action of chlorine at a red heat, etc.). A few milligrammes of the carbon were placed in a quartz tube having a capacity of 5.5 cubic centimeters. A vacuum was made by a mercury pump so as to remove the gases, taking the precaution to heat the tube over a flame before sealing it. The vacuum was as perfect as possible. The sealed tube is kept between 1,300 and 1,325 degrees C. for half an hour. At the end of this time it is brought slowly to the ordinary temperature and then opened over mercury. It was found to be no longer empty, but contained gases which exerted a certain pressure, although much below the atmospheric pressure. The latter fact shows that there is no direct communication with the air. In fact, the volume of these gases, when reduced to the atmospheric pressure, represented only 0.015 of the interior capacity of the tube. The gas is formed of nitrogen 0.9 and carbon monoxide 0.6, or a total of 1.5. The nitrogen comes from the air, whose oxygen went to form the carbon monoxide gas. Thus the elements of the air penetrated into the tube by endosmose during the experiment.

2. Amorphous carbon, as above. Weight 9 milligrammes. Capacity of the tube 29 cubic centimeters. The tube was filled with pure nitrogen and was heated for some minutes over a flame. Then the gas was rarefied, so as to lower its pressure to 16 centimeters mercury, or one-fifth the atmospheric pressure. The tube was sealed and then heated to 1,300 degrees for one hour. The internal pressure must have risen under these conditions to about 1.3 atmosphere. It had swelled out the softened tube. After cooling, the tube was opened over mercury. The volume of gas taken from the tube, when reduced to atmospheric pressure, was 7.3 cubic centimeters, that is, much superior to one-fifth of the initial volume. This gas was formed of nitrogen 0.82, and carbon monoxide 0.18. The formation of the carbon monoxide, as well as the increase in the volume of the gas, showed that the oxygen had penetrated into the tube by endosmose.

3. Hydrogen. Several experiments were made with tubes containing hydrogen, and these confirmed the former results. The following may be cited as an example. Pure hydrogen, at an initial pressure of 15.2 centimeters mercury, the atmospheric pressure being 75.1 centimeters. Capacity of the tube 5 cubic centimeters. Heat, 1,300 degrees C. Volume of gas finally extracted, 0.68 cubic centimeter at atmospheric pressure (instead of 1.0 cubic centimeter, which was the initial volume reduced to atmospheric pressure). The final gas contained 0.12 cubic centimeter nitrogen. These figures show that upon 100 volumes of hydrogen, 44 volumes disappeared, either by passage through the tube or by the action of oxygen, and 12 volumes of nitrogen penetrated into the tube. There remained in the tube only about one-half the initial amount of hydrogen.

The observations which were made upon hydrocarbon gases showed some very interesting results, and these will be given at length in a later communication. At present a few of them may be briefly stated, especially relating to the escape of hydrogen from the tube and the gradual penetration of the oxygen of the air. Naphthaline was chosen in these cases on account of its great stability, also formene, for the simplicity of its composition. In one experiment 0.051 gramme of naphthaline was placed in an empty tube having 5 cubic centimeters capacity. The tube was heated at 1,300 degrees C. In this case the tube exploded, and this is explained on account of the considerable volume occupied by the naphthaline vapor and by the hydrogen coming from its decomposition. In another experiment the tube contained 0.021 gramme of naphthaline. Its capacity was 4 cubic centimeters and it was heated at 1,300 degrees for 1 hour. The tube resisted the pressure. It was found to be full of carbon, partly brilliant and partly pulverulent. This carbon contained no more naphthaline. If all the hydrogen had been set free (0.0013 gramme, equivalent to 14 cubic centimeters when cold) the pressure at 1,300 degrees heat should have risen to nearly 17 atmospheres and the tube would have exploded. This was far from being the case. When it was opened over mercury it broke, owing to the shock of breaking off the point and also the sudden difference of pressure, and formed long fragments which are quite different from what an explosion would produce. The gases found in this case, reduced to atmospheric pressure, were but 0.18 cubic centimeter (instead of 14 cubic centimeters furnished by the carbon), and contained 0.15 cubic centimeter nitrogen and 0.03 hydrogen. This shows that the decomposition of the naphthaline into its elements, from the ordinary temperature up to 1,300 degrees and during the heat, does not take place rapidly, but gradually, and during a rather long time, in which the hydrogen escapes through the tube by degrees and burns at the outside. A little nitrogen penetrates into the tube, and its mixture with the small amount of hydrogen left in the tube only forms one-twentieth of the tube's capacity.

Pure formene gives rise to analogous phenomena which are even more strongly marked. The first experiment was as follows: Initial pressure, 37.3 centimeters mercury or one-half atmospheric pressure. Capacity of the tube, 4.5 cubic centimeters. Heat, 1,300 to 1,325 degrees for 1 hour. The tube is filled with leaf carbon and a powdery coating. Volume of gas found (reduced) 2.97 cubic centimeters, or superior to the initial volume, which is 2.25. The gas is practically free from oxide of carbon. It contains hydrogen 2.72, formene 0.05, nitrogen 0.20 cubic centimeter, or a total of 2.97 cubic centimeters. According to the original pressure of the formene, we should have had 4.50 cubic centimeters of hydrogen. Hence we see that about a third of the hydrogen escaped or was burned, since the formene is nearly all decomposed.

In the second experiment with pure formene, the original pressure was 36.0 centimeters mercury (atmosphere = 75.6). Capacity of the tube, 4.0 cubic centimeters. The tube was heated to 1,100 degrees during half an hour, then cooled without opening. It was filled with free carbon as above. The next day, it was reheated for one hour and brought to 1,300 degrees, then kept for one hour at that temperature. After cooling, the tube had become white and transparent, without keeping a trace of carbon. I thought at first that a crack in the tube had let in the oxygen, which had burned out the carbon, but this was not the case. In fact, upon opening it over mercury two hours afterward, it was found that the pressure in the tube was about one-half the atmospheric pressure (or near what it was at first), which excludes the idea of a perforation, as this would have established the equilibrium with the air. The tube contained 2.12 cubic centimeters of gas, mainly nitrogen, with a little oxygen and carbonic acid. These facts show that the air had entered the tube gradually by endosmosè during the second period of the experiment. In this way two volumes of formene, or rather the corresponding oxygen and hydrogen, had been gradually burned, both outside the tube or in the interior, at the expense of the oxygen of the air. Thus we see that the quartz tubes should not be heated for a very long period.

These phenomena make it evident that silica when melted and then solidified acts in regard to gases like an animal membrane, capable of endosmose and exosmose. The character of these actions depends upon the thickness of the tube, the softening, the adherence of carbon and other matter to the inside, the proportion of alkali added to the silica, the successive temperatures of the heating and the duration of the latter. Also we must reckon the difference of pressure between the variable gases in the tube and the outer air.—Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from Comptes Rendus.

HUACA AT LA TORRE, NEAR LIMA.

RECENT EXPLORATION IN PERU.

Soldering Powder for Steel.—Melt in an earthen pot 3 parts of borax, 2 of colophony, 1 of potassium carbonate, as much powdered hard soap, to which must be added 3 parts of finely powdered glass and 2 parts of steel filings. The melted mass is run out upon a cold plate of sheet iron, and when it is completely chilled it is broken into small bits or finely powdered. To solder with it, it is necessary to sprinkle with it the surfaces to be joined, several minutes before bringing them together.

OUR SUN AND "WEATHER."—II.*

By WILLIAM J. S. LOCKYER, M.A., Ph.D.

IN confining this study, therefore, to pressure, the first step is to see whether the pressure does change from year to year, and then, if it does, to see if the curves which indicate this change are similar to those which represent the variation in the number of the solar prominences. Taking the Indian region, for rea-

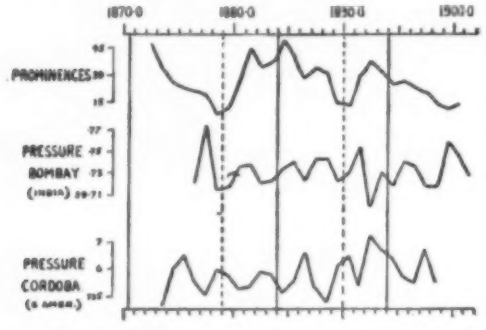


Fig. 7.—Curves to illustrate the wavy nature of the eleven-year prominence change and its relation to the atmospheric pressure variations that simultaneously occur in India and South America.

sons previously given, the reader will notice that the Bombay curve in Fig. 7 does exhibit short-period waves which agree for many years with those on the solar prominence curve; it is important to note, however, that the main eleven-year variation of the prominences is not so conspicuous as the shorter-period changes. The apparent secondary nature of the former and the pronounced character of the latter is a conspicuous feature of pressure curves nearly all over the world. It will be gathered, therefore, that greater attention must be given to this short-period barometric change.

Since the rise in the prominence curve denotes greater solar activity, and this is coincident with an excess

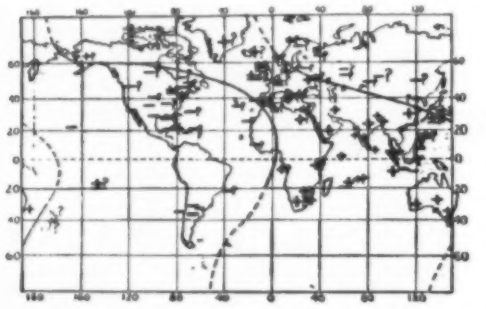


Fig. 8.—Map illustrating the positions of the two large pressure area types, namely India (+ and +?) and South America (— and —?), which behave inversely to each other. The neutral line appproximately divides the earth into two equal portions.

of atmospheric pressure over the Indian area, and since this latter means that a greater amount of air than usual is piled over India, some part of the world should be experiencing the reverse conditions; in other words, there should be a large area on which a deficiency of atmospheric pressure exists simultaneously. Now this is exactly what happens, only one has to go to the other side of the world to find the locality. In such a region, then, the curve representing the pressure variation should be the reverse of that of India, that is, when there is excess pressure in one year in India, there should be in the same year a deficiency in the other. If the reader will glance at the accompanying

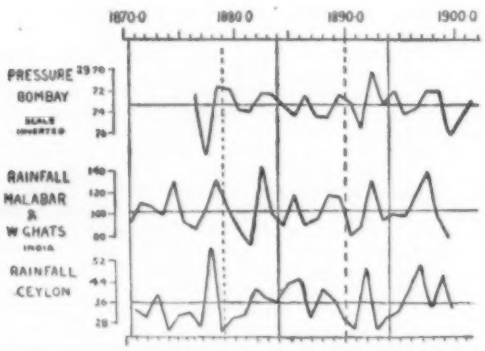


Fig. 9.—Curves to show the relation between years of low pressure over the India area and the rainfall on the west coast of India and Ceylon during the Southwest Monsoon period.

diagram (Fig. 7) he will see the curve of the pressure variation at the observatory at Cordoba in South America, a locality in nearly the antipodal part of the world to India. This curve is nearly the exact opposite in every detail, and if one be reversed and compared with the other, their similarity can be more easily observed.

* Knowledge and Scientific News.

The fact that when there is an excess amount of air over the Indian area in some years, and a corresponding deficiency over the Cordoba region during the same years, or a deficiency over India when there is an excess over Cordoba, makes one immediately inquire, What occurs at other places on the earth's surface? Such an investigation has led to some most interesting conclusions. Australia, for instance, like Arabia, Ceylon, East Indies, Straits Settlements, East Africa, Mauritius, etc., behaves like India. On the other hand, South America, the southern parts of the United States, and Honolulu, resemble the Cordoba type of pressure variation. Thus we have the world divided into two portions which behave in opposite ways as regards these barometric changes. As was to be expected, those regions neighboring the limits of these two large areas are somewhat indeterminate, and sometimes favor the one and sometimes the other. The accompanying map (Fig. 8) will convey at a glance this pressure distribution, the Indian and Cordoba regions being indicated by a (+) and (—) respectively; the indeterminate areas are shown by a (± ?). The latter can be easily seen by following the track of the neutral line which approximately divides the eastern and western hemispheres.

The detection of this pressure variation may turn out to be an important clue to the close connection between the meteorological behavior of regions which are widely separated. Thus to mention one of many incidences, Sir John Eliot has recently pointed out that the drought in the Indian region during the years 1895-1902 was a more or less general meteorological feature of the whole area, including Abyssinia, East and South Africa, Persia, Baluchistan, Afghanistan, probably Tibet, and the greater part or whole of Australia. Since these areas all lie within the Indian type of pressure variation above described, their meteorological connection seems undoubted.

Many people are more familiar with rainfall variations than they are with those of pressure, so that the importance of the latter can best be shown by indicating how rainfall is affected by pressure. As a general

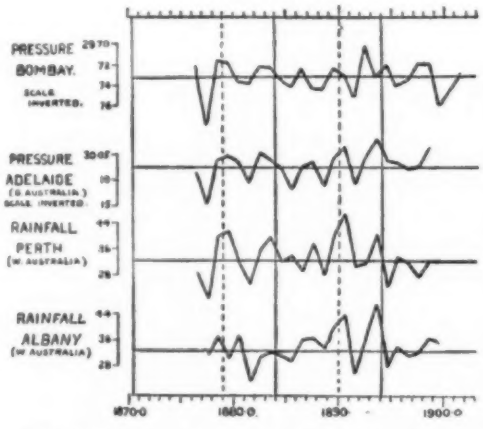


Fig. 10.—Curves to show the close relation between the pressure variations in India and Australia, and the rainfall in the latter country.

rule low pressure means increase of rain, but this is not always the case. The main point to be considered in this connection is the nature of region, that is, whether it is land or water over which the air current has passed, before it reaches the area in question. Thus what may be a rain-bearing current for one part of a continent may under similar low pressure conditions be a dry one for other parts and *vice versa*. The lie of the land in relation to the water surface must, therefore, in every case be taken into account, and it is for this reason that the direction of the prevailing winds becomes one of extreme importance.

In the first place, let the pressure and rainfall of the west coast of India and Ceylon be compared, but in both of these cases the rainfall of the southwest monsoon period will be dealt with alone. India, as is well known, receives its greatest quantity from the strong moist air current which strikes the country from its southwest quarter. The strength or weakness of this current means prosperity or poverty to the country. A failure of these rains foretells for many districts a terrible drought and consequently loss of crops, a famine, and a great expenditure of money. Since the west coast of India is most exposed to the southwest monsoon wind, and is not shielded by mountains except on its eastern side, this region should respond in its rainfall to the pressure variations. In the Ceylon rainfall curve only those months have been included during which the southwest monsoon wind is blowing.

In order that the reader may more easily compare curves of pressure with those of rainfall, the former have been inverted. The highest points of the pressure curves therefore mean lowest pressures, and these correspond with the peaks of the rainfall curves which denote years of greatest rain. A glance now at the accompanying diagrams (Fig. 9) will illustrate the close resemblance between these two meteorological elements. In both the rainfall curves similar kinds of variations seem to exist, but the rainfall of Ceylon appears to anticipate to a small extent that of the western coast of India. Thus years of low pressure for these regions mean, on the average, years of good monsoon rains.

Now, not only does this connection hold for this portion of India, but the same happens in the case of some parts of Australia. Years of deficient pressure there mean years of excess rainfall. Since the pressure variations are nearly similar to those in India, good rains should occur in the same years. The annexed diagram (Fig. 10) shows the state of affairs at Adelaide, Perth, and Albany, the pressure curves of all these places being very similar. Excess low pressure

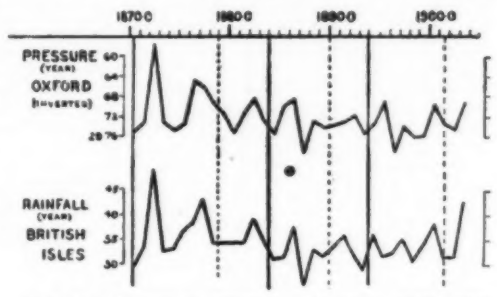


Fig. 11.—Curves to illustrate the close relationship between the variation of pressure over the British Isles (Oxford taken as the type) and the mean rainfall, from the Meteorological Office Statistics, over the whole of Great Britain.

corresponds to excess rainfall. What lack of rain means to this colony only those who have experienced a droughty season there can vividly testify; but the millions of sheep that have died through want of water in the last few years indicate the importance of the value of rain.

In our own isles a similar relation of pressure and rainfall holds good. Low pressure on the average means a greater number of cyclones, while high pressure means anti-cyclonic conditions on the average. The rainfall of Great Britain on the whole is chiefly dependent on the winds which reach this country from the Atlantic, that is, southwest winds, or, in other words, on cyclones which pass over the country in a direction northeastward. Since cyclones denote low-pressure areas, the rainfall is directly dependent on pressure. A perusal of the accompanying diagram (Fig. 11) shows how intimate this relationship between rainfall and pressure is, for the curves (the pressure curve is here inverted) are so very closely similar.

Unfortunately, the British Isles, which display pressure variations intermediate between India and Cordoba, are a sort of half-way house, and have therefore rather a mixed type of pressure variation; there is thus some difficulty, with our present knowledge, in foretelling a year in advance whether the pressure will be in excess or deficient.

Although this short-period variation of pressure is, perhaps, the most important that is indicated in meteorological observations, and the reader can judge this from the curves here shown, it is not the only one acting. In many cases that have been examined, the most distinct variations are those which extend over several years, and correspond to the thirty-five year sun-spot variation previously described, and to that covering about eleven years. The prominence record is not sufficiently long to say whether this class of solar disturbance has a period of variation of thirty-

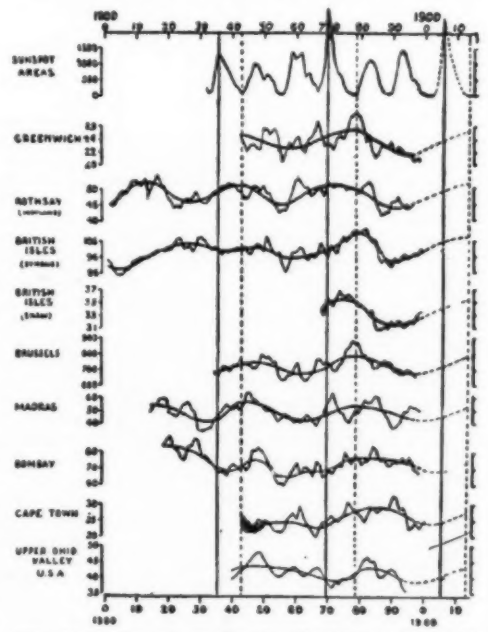


Fig. 12.—Some curves showing the long-period variations of rainfall and their relation to the 35-year solar change as indicated by the vertical dotted lines, and the eleven-year solar period.

five years, but the eleven-year change is most pronounced.

The thirty-five year weather cycle, or Brückner cycle, as it is called, because Brückner was the first to clearly demonstrate its existence, has for many years been suggested. Thus Bacon many years ago wrote: "There is

a toy which I have heard, and I would not have it given over, but waited upon a little. They say it is observed in the low countries that every five and thirty years the same kind and suit of years and weathers come about again; as great frosts, great wet, great droughts, warm winters, summers with little heat, and the like, and they call it the Prime." Again, in Australia there was an impression as long ago as the year 1836 that the seasons underwent a variation every nine or ten years, varying, however, every third series or thirty years.

Now Brückner has shown that there is a thirty-five year period both in pressure and rainfall, the years of high pressures corresponding to those of less rainfall. This long-period variation is of very great importance and must be reckoned with in long-period forecasting, although it is not so prominent as the short-period changes that have been described above. The accompanying set of curves (Fig. 12) will perhaps serve to illustrate this long-period variation of rainfall for a few stations on the earth's surface, while the curve at the top indicates the relationship between the epochs of the dry and wet periods and those of the great solar variation of thirty-five years described in a previous paragraph. It must not be forgotten that to determine this long-period variation from the rainfall records the means of several years have to be taken together, and even when every five-year values have been employed the resulting curves have to be again "smoothed," as it is called. In some of the cases it will be seen that the five-year means render apparent the eleven-year variation, a variation which seems more distinct in tropical regions, such as India, than extra-tropical regions.

A glance at the curves is sufficient to indicate the existence of these variations. From a study of these variations at many places scattered over the earth's surface, it has been found that the maxima or minima do not occur at the same epochs at all places; at present this question has not been worked out, but it may possibly turn out that, like the short-period pressure variation, there is a give and take between two large regions on the earth, in which while the maximum rainfall is occurring in one region the minimum is taking place in the other.

Fortunately for us who dwell in Western Europe, it will be seen from the curves that we are entering on a series of years, which, *on the average*, will be wet, after having just experienced a number of years during which

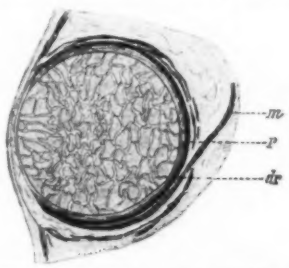


FIG. 1.—LUMINOUS ORGAN DIRECTED OUTWARDLY TO THE LEFT.

Greatly magnified.

the rainfall was very much below normal. The rainfall of 1903 practically put an end to this long drought. It is important to remember that the short period of about four years is the most prominent variation of rainfall, and is always at work. It is thus quite possible to have a comparatively dry year when the long-period rainfall variation is at a maximum, but on the average the wet years will be wetter and the dry years less dry at such an epoch. At the minimum of the long-period cycle the wet years will be less wet and the dry years more dry.

Enough, perhaps, has been said to show that the rainfall variations all depend on the atmospheric pressure changes that occur. These latter are apparently closely associated with the solar cycles whether they be indicated by spots or prominences. We are thus led to deduce the most probable—and, after all, the most natural—conclusion that the sun is the most important factor in producing our varied weather.

We have become acquainted with three periodic variations of solar activity, covering about four, eleven, and thirty-five years each. The question arises—Are there any other variations of longer period which may help to complicate the solar problem, and, consequently, the meteorological one as well?

It may be said, however, that no other periodic variation extending over a year has yet been traced, as the time over which the observations extend is at present too short.

The lengths of the periods which have up to now been discovered have, however, such a peculiar relationship to each other that perhaps a means is afforded of suggesting a fourth period. If we take the length of the shortest period as our unit, namely, 3.8, and multiply it by 3, we obtain 11.4, which is very near our second period, which is 11.3; if we again multiply 11.4 by 3, we have 34.2, which again is close to 34.8, the real value, as far as can yet be determined, of the thirty-five period. Now, if we multiply 34.2 by 3 again, we obtain 102.6, which may be the length of a new period. The above numbers, put in tabular form, show the curious relationship between the periods perhaps better:

$3.8 \times 1 =$	3.8, value actually determined	3.8
$3.8 \times 3 =$	11.4, value actually determined	11.3
$3.8 \times 6 =$	34.2, value actually determined	34.8
$3.8 \times 9 =$	102.6, value actually determined	?

To advance the knowledge of weather changes, solar variations must be most carefully watched. For a successful solution of the weather problem, the two sciences, Solar Physics and Meteorology, must go hand in hand, and the saying "unity is strength" no less applies to matters scientific than it does to other affairs of life.

LUMINOUS ORGANS OF DEEP-SEA FISHES.*

A GREAT many, though not all, deep-sea fishes possess luminous organs which, though they vary remarkably

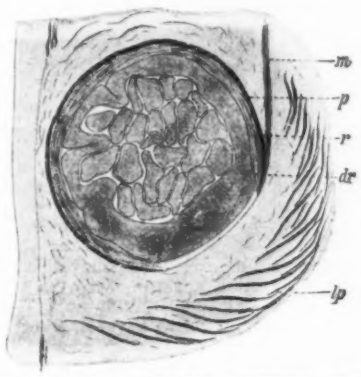


FIG. 2.—LUMINOUS ORGAN TURNED INWARD BY MUSCLES *m*, AND FURTHER OBSCURED BY PIGMENT LAYERS, *lp*.

Greatly magnified.

in details in the different species, yet show a general resemblance to each other and to the analogous organs of cuttle-fishes. These luminous organs (Figs. 1 to 4) consist essentially of gland cells (*dr*) which are entirely filled with secreting nuclei and may be regarded as the source of light. Under these cells lies, usually, a thin layer of narrow and closely-packed cells which acts as a reflector (*r*); between the luminous cells and the skin are interposed cells of strong refractive power which may be regarded as forming a lens, and the whole organ is enveloped, except on the side nearest to the skin, in a mantle of dark pigment cells (*p*).

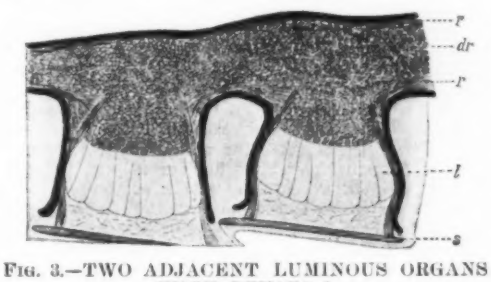


FIG. 3.—TWO ADJACENT LUMINOUS ORGANS WITH LENSES *l*.

The luminous organs are found in various parts of the body; the head, the gill covers, the fin-rays which have been metamorphosed into tentacles, the bristles, and the trunk. They occur both singly and in groups (Fig. 3). Some of them are furnished with muscles which enable them to be turned inward, so that the light suddenly vanishes (Fig. 2). Their great diversity in structure is supposed to indicate a corresponding diversity in the color of the light emitted by them. The biological significance of these organs can only be conjectured. It is not even certain that all of them are luminous, but their luminosity is inferred from their resemblance to the few that have actually been observed to give light; and the fact that the eyes of deep-sea animals are formed differently from the eyes of their congeners living in daylight suggests an adaptation to the phosphorescent light emitted by the luminous organs.

As these organs are distributed over the body in an arrangement peculiar to the species, and shine with light of various hues, it is inferred that they serve, like the pigment cells of daylight animals, to form a characteristic specific pattern. Deep-sea fishes, therefore, are not black, as is often asserted, but are brilliantly colored, the black skin serving merely as an effective background to their varied tints.

The chief biological function of the luminous organs is to facilitate mutual recognition between members of the same species and, consequently, the mating of the sexes. Some of them are actually secondary sexual characteristics, for they appear on the back of the male and the belly of the female, and do not develop until the reproductive organs have reached maturity.

Especially interesting are certain small luminous organs, found most frequently in the eye cavity, which open, or shine, not outward, but inward. Fig. 4 shows a

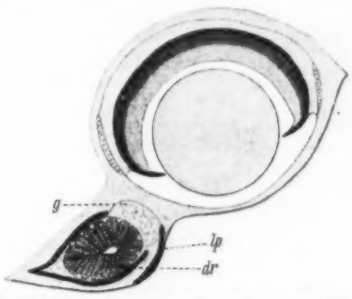


FIG. 4.—EYE OF DEEP-SEA FISH WITH ADJACENT LUMINOUS ORGAN SHINING INWARD AND SHIELDED OUTWARDLY BY PIGMENT LAYER, *lp*.

Greatly magnified.

simple case. The probable morphological interpretation of this is that the organ originally shone outward, but has become covered with a fold of the skin, and a possible physiological advantage is that the faint illumination of the eye may make it more sensitive to differences of color between species.

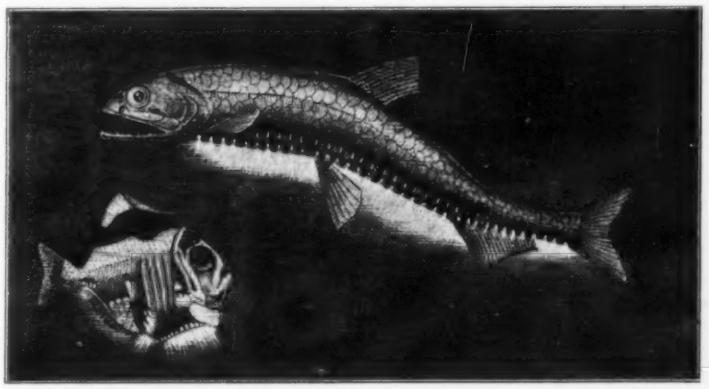


FIG. 5.—DEEP-SEA FISHES WITH LATERAL ROW OF LUMINOUS ORGANS.

* Abstract of a paper read by Prof. Brauer before the German Zoological Society.

THE NATIONALITY OF FISHES.*

By F. G. AFLALO.

IF the fisherman puts before himself a blank map of the world on what is known as Mercator's Projection, and thereon jots down some of the known geographical limits of sundry groups of fishes, he finds himself confronted with strange problems. With a fish in a pond it is the same as it was with Gen. MacMahon in the Malakoff: "*J'y suis, j'y reste.*" How any kind of fish originally found its way into a landlocked water without present outlet is a question that can be answered only by a careful investigation of whether some outlet did not previously exist. The species may have been introduced by man, or, like Topsy, it may have got there no one knows quite how. But of its remaining—since, unless released by a flood, or suffocated by a drought, or snatched by an otter, or caught by an angler, it has no choice—there can be no shadow of doubt.

A similar restraint, less only in degree, keeps the greater part of river-fishes to their native water; for, with a few known exceptions, they are unable to survive in the brine. The eel, it is true, goes down to the sea to breed; and the salmon and sea-trout, which may be a valid species or a form of brown trout, travel backward and forward between the head-waters and the open sea. But the case of the salmon family is a special one, and men of science are evenly divided in opinion as to whether the family was in the beginning marine or domiciled in the inland waters. At any rate, several of its members divide their time between the two. These salmonoid fishes belong, with a single exception, to the waters north of the equator. The exception has a special interest for the fisherman with geographical knowledge, for it is a small New Zealander of slight economic importance, but attractive on other grounds, since its natural occurrence in the rivers and estuaries of that distant colony makes it an error to regard the acclimatized trout as the first member of the salmon family to live in these waters. What is perhaps even more interesting to the student of distribution is that the little fish (*Galaxias*) which the early

* Chambers's Journal.

settlers in that country called "trout," is not a salmonoid at all, but is so dispersed over the Mercator map as to puzzle even the learned. It is truly the most southern of fresh-water fishes, for the thirtieth parallel south determines its northern range, and it is in fact found only in the streams of Cape Colony, Patagonia, and the Falkland Islands, and in the southernmost waters of Australasia.

The case of sea-fish looks at first sight distinct from that of the dwellers in rivers and lakes, for the free and open ocean seems without interruption from the North Atlantic to the South Pacific, and the uninformed might be tempted to expect to find the same fishes in both hemispheres: the schnapper and barracoota sporting round the Eddystone, and our plaice and pollack in the fish-shops round Sydney Harbor. But those who have fished in both places know how different is the harvest of the sea ten thousand miles apart. The visitor at Margate is told by the inevitable longshoreman, who always tenders such lore in return for potential draughts of home-brew, that if he stands at the pier-head and faces just west of north he is looking straight across at Greenland. What is more certain is that you can stand on the Land's End, and, in imagination, gaze across four or five thousand miles of sea to the coast of South America without a single charted island between. Yet between Penzance and Paramaribo considerations of temperature impose barriers in the path of the restless fishes as forbidding as if they were walls of rock.

Even in so small a tract of sea as that which lies around the island in which we live, there are apparently impassable barricades. The wolf-fish, whose ugly head may be seen on most days of the year at Scarborough market or Berwick quay, would probably attract a crowd if exposed for sale on Plymouth Barbican. *Per contra*, the pilchard, which shoals in its hundreds of thousands in Cornish moonlit bays, is rarely, if ever, seen alive on the coast of Yorkshire. The mackerel seems to resent a Fahrenheit temperature appreciably below forty-five degrees, and the greater mackerel-fisheries consequently belong to the southern shores of Britain and Ireland, whereas the herring is more in evidence in the northern waters. Two other northern forms of great interest are the bergylt and torsk, the former being also known as "Norway haddock," and though neither a haddock nor particularly characteristic of Norway, it is often brought into Grimsby from the North Sea grounds, and is occasionally taken in the Moray Firth. To the naturalist its chief attraction is that it brings forth living young, a method of reproduction common to very few British fishes. The torsk, which reaches a weight of over forty pounds and a length of forty inches, is a well-known Shetland fish, excellent eating when fresh, but known in more southern markets in the dry state only. It is a slimy fish to the touch, owing to the minute size of its embedded scales, and it has the beard distinctive of many members of the cod family. Mr. C. O. Minchin, an angler with experience of many seas, tells me that the longshore fishermen of Coll, in the Hebrides, had never seen torsk before one occasion when he was present. In Norway the name is applied indiscriminately to several small allied fishes of the cod tribe, having affinities no doubt with *dorsch*, a small codfish that I saw every day during a winter on the shores of the Baltic.

Perhaps the most extraordinary case of what we may call overlapping distribution is that of the three top-knots, commercially insignificant cousins of the plaice. Three of these are found on one part or other of the eastern seaboard of Britain, but one only enters the Mediterranean, occurring nowhere north of Shetland; a second ranges to the Arctic Circle, but ceases south of the Bay of Biscay; while a third, with an extraordinarily restricted domain, occurs only between the English Channel and the Norwegian coast. Some allowance must be made by the open scientific mind for accidents of capture; but the results of very many dredging expeditions warrant the foregoing account of the geography of *Zeugopterus*, which is the more dignified equivalent of the trivial name.

A more appreciated cousin of the top-knots is the sole, and it is a fact that the delicate sole of the more southern portions of the North Sea and of the littoral of the English Channel is almost entirely replaced in Scotch waters by the much less agreeable lemon-sole. This it was, no doubt, which induced Prof. McIntosh to transplant some living soles from the coast of Northumberland to Scotch waters. Whether his experiment has resulted in the supply of the genuine article for the "sole" of Edinburgh hotel menus, I have not been in the northern capital recently enough to learn. Mr. Dannevig made a similar essay to acclimatize North Sea plaice in the bays of Australia, with what success is also as yet undetermined.

That the Strait of Gibraltar, however formidable to the warships of Britain's enemies, should stop the passage east or west of migrating fishes looks at first sight impossible. Yet neither the cod nor the herring, both plentiful in the North Sea and the Atlantic, enters the Mediterranean, though a near relative of the herring, the pilchard, known in southern markets as the sardine, is abundant in that sea.

One or two of the world's seas approximate the conditions of lakes, with the water either very salt (as in the Dead Sea), very fresh (as in the Baltic), or almost normal (as in the Black Sea). Each of these has its peculiarities for the fisherman. The Dead Sea, subject to continual evaporation, is highly saline, and its asphaltic water is so baneful to fish-life as quickly to suffocate any fishes washed down when the Jordan is in spate. In the neighboring Sea of Galilee, on the other hand, the fish are almost as plentiful to-day as at the time of the miraculous draught; among the more common kinds being a catfish, which makes itself at home in the baked mud when the waters of the Holy Land are dried up by the burning sun. Visitors to the fish-markets of Nazareth and Safed are frequently struck by the proportion of fish minus their eyes. This is the work of pelicans and fish-hawks; and, though it is ascertained that the eyes must have been gouged out when the fish were young, the loss of their eyesight appears to be no bar to an otherwise prosperous condition. It has been pointed out that many kinds of fish are common to the Jordan and the Upper Nile, and it would look as if these fresh-water fishes were dispersed, by some line of communications since destroyed, from a center of distribution that has probably contracted to the water which we know to-day as Lake Tanganyika. The Nile, like most African rivers, is not rich in important fishes, though Mr. Boulenger has of late years described collections of great interest to science. In the rivers of Morocco I never succeeded in finding anything superior to eels and barbel, though shad regularly enter some of the estuaries, and there are said to be trout in the streams of the Atlas. As to the Nile, the late Charles Williams, who served as war correspondent on three Nile expeditions, once told me that he had seen only three kinds of fish caught in that river. One, a small bream-like fish, was useless as food. A second, which made a passable dish when there was no choice, was a siluroid, which Thomas Atkins became expert in catching on an ammunition hook baited with bully beef. A third, which looked something like our mackerel, though lacking the bars, he saw caught on a stern-line from one of the river-steamers.

The Baltic, which lies in latitudes too cold during the greater part of the year to promote evaporation, receives immense fresh-water rivers. Hence its fishes are closely allied to riverine forms in some cases; and, with a few notable exceptions, its cod and herrings are dwarfed by comparison with the more robust races taken in the North Sea nets.

The Black Sea has a bed so thickly strewn with deleterious sulphur compounds that the lower strata of the water are permeated with sulphide of hydrogen. Now, the eel spawns only at great depths. This is perhaps the reason of its leaving rivers to spawn in the sea. As the uttermost depths of the Black Sea are poisonous from the cause here indicated, there are no eels whatever in that sea, though many of its other fishes are of great commercial value to the Russians.

Two other cases of apparently inexplicable distribution, analogous in some respects with the afore-mentioned association between the Nile and the Jordan, are those of the surviving lung-fishes and arapaimas or osteoglossids. Only three genera of lung-fishes survive out of at least double the number, and of these one occurs only in South America, one only in Africa, the third only in a couple of rivers of Queensland. None exist in either Europe or Asia, and indeed the range of the three in question is in each case very restricted within its own continent. The arapaimas are found only in the Brazilian region, in Central Africa, and in Sumatra, Borneo, and Queensland. The osteoglossid of the last-named country is known by the name of *barramunda;* but I found that this name was very carelessly applied to three very divergent forms: the osteoglossid, the lung-fish (*Ceratodus*), and the giant perch.

The distribution of the salmon family has already been referred to. A very curious and interesting episode of salmon itinerary is seen in the joint estuary of the Avon and Stour at Christchurch, in Hampshire, where 90 per cent of the fish ascend the former river. This is intelligible only to any one who knows the difference between the limpid Avon and muddy Stour. In like manner, the salmon and trout of Belgium both prefer the clear waters of the Meuse to the discolored floods of the Scheldt.

There is an insignificant little fish, in appearance not unlike a diminutive perch, known in Britain as the pope or ruffe and in France as *grémille*. For some unaccountable reason this small fresh-water fish is growing scarcer in the rivers of Spain and Italy. In France, on the other hand—where, if we may judge by the silence of Belon and other early writers, it was unknown previous to 1777—it seems to be becoming more plentiful every year in the Seine, Aube, Yonne, Meuse, Garonne, and Dordogne.

Thanks to the inquisitive research of modern science, we know approximately what kind of fish to expect in every quarter of the globe, though the extreme depths of the ocean are likely to retain their jealously guarded secrets for a long while to come, in spite of the latest improvements in dredging apparatus. The rivers of Africa, like the lakes of New Zealand, have in great measure been mapped out by the ichthyologist; and in the last the enterprise of the Anglo-Saxon has repaired the omissions of Nature, with the result that these waters now yield splendid fish undreamt of by the primitive Maori.

Man's share in distributing living fishes is considerable, even apart from such unforeseen and unconsidered accidents of engineering as that which, through the Suez Canal, opened the Mediterranean to the sharks of the Red Sea. His planned interference in the natural range of fishes has been attended by variously desirable results. French and Belgian anglers are not to-day so unanimous as they were in respect of the merits of the American catfish, introduced into their rivers with such enthusiasm a few years ago. If America has sent her undesirables to European waters, has she not also given hospitality to other suspects traveling west? The carp, first introduced experimentally into Lake Erie by the United States Fish Commission, has made itself at home to such purpose that that lake alone is said to give an annual yield of three million pounds weight! Yet, however satisfactory it may be on commercial grounds, American sportsmen look askance at the carp, for the bass-fisherman says that it devours the spawn and fry of his favorite fish, while the duck-shooter declares that it ruins his prospects by tearing up the weed and fouling the water, the ducks being driven elsewhere by such outrage.

Save for occasional experiments with rainbow trout, we do little acclimatizing of exotic fish in this country, the work of our fishery boards being rather directed toward preserving our indigenous species and eradicating pike and coarse fish to make room for trout. The Salmon Board of the Yorkshire Esk has of late been much exercised by the proposal of a riparian owner to introduce into that river the grayling, a favorite fish with anglers in other parts of the broad county. It is doubtful whether the Board would have power to interdict a riparian owner minded to introduce what is recognized as a game-fish; but there can be little question about the Esk being a "hungry" river as it is, the existing salmon and trout having none too much food. The introduction of grayling, then, apart from the complication in the fishing seasons, since the open time for grayling does not correspond with that for trout, is likely to make the case of the prior occupants harder than ever.

These attempts to edit Nature, regarded from the standpoint of sport, will be condemned by the angling masses, however warmly they may be supported by men of means and leisure. The reason is obvious. Workingmen anglers, accustomed to coarse fishing, have neither the money nor the inclination for fly-fishing; and the pike, the usual object of extermination, is one of the poor sportsman's favorite fish. It is fatal to fly-fishing for more reasons than one, for not only does it prey on the trout-fry, but its presence among the reeds prevents the larger fish from rising to the fly as surely as a falcon or artificial kite overhead keeps the partridges crouching in the stubbles. The predatory pike, which (on paper) keeps on one side of an imaginary line drawn across Scotland, is, like the pugnacious stickleback, a fish of northern latitudes only. The pike tribe occurs nowhere south of Italy (not even in Sicily) in Europe, and the stickleback ceases south of Algeria. The range of both families in the New World is of latitudinal coincidence with these limits. But, as was already suggested above, there is nothing incomprehensible in the limitations imposed on these fishes of fresh-water. It is when we find the marine forms obeying a mysterious injunction of "Hold! no farther!" that we have to catch our breath in amazement.

VARIABLE STARS.*

By ALEXANDER W. ROBERTS, D.Sc.

ALL down the ages the stars have been regarded by thoughtful men as the type of nature in its unvarying moods and manifestations. On this earth of ours we find, everywhere and always, an unceasing ebb and flow of the tide of human affairs: birth and death, growth and decay. Men come and go; empires rise and fall; even civilizations dawn, culminate, and set; but amid all these changes the stars in their high heaven shine on, seemingly untouched by decay and unaltered by the effacing hand of time. They, to all appearance, change not with the changing years. Unmoved, as if their foundations rested on eternity, the "fixed" stars keep their appointed places, while their brightness grows not dim with the passing of man's centuries. The sky shares with the sea and the great mountains the charm of perpetual youth; and this is why the hearts of men are irresistibly drawn out to the hills and the seas and the stars.

Yet, after all, this seeming fixity of place, this apparent constancy of light, is far, very far, from being an actual reality. The stars, in common with all created things, come within the grip of the universal laws of growth, development, and decay. Instead of fixity, therefore, there is movement of the most stupendous nature; instead of constancy, there are changes of such magnitude that we have nothing on earth to which we can liken them. Most of these changes and movements, however, take such long periods to unfold, because of the distance and size of the stars, that in the lifetime of a man, or even of a nation, the face of the sky, like the outline of some majestic range of mountains or the shores of a vast ocean, bears ever the same appearance. But in the lapse of long ages the shores of ocean alter, the outlines of the mountains change, and the stars vary in brightness and color and position.

To follow out our analogy yet a little further: just as the surface of the sea and the slopes of the mountains, while preserving the same unvarying aspect as a whole, yet in their parts—their waves and their slopes, their reaches and their valleys, the sheen of their waters and the brightness of their foliage—change with the days and the seasons, so the heavens as a whole ever present to earth the same majestic formations; yet not a few of the stars that go to make up this seeming unchanging whole vary in brightness so rapidly and so orderly that even in the brief span of a man's life we are able to ascertain the laws which regulate their variation.

I think a simple illustration will make this clearer.

* Chambers's Journal.

I have often pictured to myself the thoughts and feelings of some ancient astronomer, say one who lived in the days of Abraham or Job, if he were to return for a brief season to this time-fretted earth of ours and find himself once more in the stream of earthly concerns. What perplexity, what amazement, what curiosity would be his as he wandered up and down the busy streets of even a slowly changing Eastern city! How much would be new to him, how much would be strange and perplexing: steamers and trains, telegraphs and telephones, tram-cars and motor-cars! But I can best of all imagine his excited wonder and eager curiosity as he passes within the portals or stands beneath the mammoth dome of one of our modern observatories.

"What is this: a place for observing the stars, you say? And this huge engine: a telescope do you call it? I also, in that far-off yesterday when I sojourned on this earth, possessed an observatory; but it was not at all like this. It was only the flat roof of a lofty tower near the wall of the great city of Nineveh; but it was the finest observatory in all the East, and men came from far and near to view the pictures of the sky that I drew on my clay tablets. So much has changed since that day that I suppose the stars I used to observe four thousand years ago will all have passed away. Alas! I am indeed a stranger in a strange land."

And now the day draws to a close and the night gathers in. Soon the darkness shrouds from sight all that men had wrought and accomplished during the centuries. Slowly one by one the stars creep forth: great Orion and the Northern Bear, Sirius and Aldebaran, the Hyades and Pleiades, Vega and Arcturus.

As their light shines forth on the darkening world the feeling of strangeness and sadness passes away from our visitor, for there above him are the same stars that he used to watch and chart ages ago. How often had he seen them rise from out the Eastern haze or set behind the Syrian hills! The world might have changed, had indeed changed, but here was an unchanging canopy of glorious light.

And thus the centuries roll away, and in imagination he is back once more in his lonely watch-tower by the city wall; once more he is eagerly scanning the face of the sky and comparing it with those pictures he drew forty centuries ago. Forty centuries? Surely not, for the stars are just the same as they were when he lived and watched and prayed under them.

Yet stay! Not quite the same: surely Sirius was redder then than it is now? And the Pleiades look different. Were there not seven stars? Can one be lost? It must be, since now there are only six. And then, over there to the south, in the Scorpion, is a bright star he never remembers having seen before. When and how did it come into existence? He must return another night and more carefully examine the face of the sky; for, while the general features are the same, here and there he has discovered distinct evidences of change, whether changes indicating coming age or growing manhood he is unable to say. And so he comes to our modern observatory night after night, and each succeeding evening he lights on objects which were unknown to him in his Nineveh days: stars which have sprung into existence somehow and sometime during the passing of the centuries. Then, again, he searches in vain for many an old friend. The lost Pleiad is only one of many whom darkness or decay or destruction of some kind has overtaken. One day the mystery of stellar variation and change so oppresses the soul of our visitor that he returns no more to carry on his investigations. And this is the last we know of him.

Now let us leave our parable and concern ourselves with actual history, which, after all, is not so very different from what we have in imagination set forth.

When the father of astronomy, Hipparchus (B. C. 130), compared his maps of the sky, or rather his catalogue of the brightest stars, with those made centuries before his day, he was convinced of the occurrence of changes in the position and brightness of the stars. Indeed, during his own lifetime one bright star suddenly appeared in the constellation of the Scorpion, and then slowly faded away again.

It was the desire to provide material for the detection of phenomena so rare and striking as the sudden appearance of new stars or the disappearance of old ones that led one astronomer after another to draw up catalogues or make charts of the stars. And their labors were not fruitless, for between Hipparchus's day and the beginning of the sixteenth century four new or temporary stars were discovered. If, as some writers urge, we include the star of Bethlehem also as an appearance of a beautiful and brilliant temporary star, this would be five such remarkable occurrences in the period lying between the rise of ancient and the birth of modern astronomy.

Since the discovery of the telescope and the multiplication of observatories all over the globe, the number of new stars detected has slightly increased. It is, indeed, scarcely possible now for one to escape the meshes of the photographic net set for its capture in many a corner of the world, and thus scarcely a year passes without one more being added to the number already known. These stars are of the same character as and are probably due to the same causes which brought into existence the famous star that recently blazed out in the constellation Perseus, a description of which has already appeared in the pages of this Journal (1903, vol. vi., No. 264).

It is impossible to predict when or where a new star will appear, just as it is impossible to tell when or where a boiler explosion will take place in Glasgow. And when one does appear, it is equally impossible to say what its life-history will be. It may remain bright for months, or may swiftly fade away into the darkness whence it came. It may have secondary outbursts of brightness, like that of the well-known southern star Eta Argus, blazing up again and again, as if some giant hand were stirring at intervals the vast stellar fires. Or it may decrease steadily in light for months, and then, in a fit of seeming sulkiness, suddenly stop waning. There is no telling what new stars may do. They are erratic in their coming and going, but like all erratic things, they are always interesting.

Mankind had been on the watch for new stars or had been carefully observing old stars for nearly two thousand years before they lighted on a second and even more wonderful class of variable stars.

As the sixteenth century was drawing to a close one Fabricius noticed that a certain star in the Whale fluctuated considerably in brightness. At certain times the star was a conspicuous object in the sky; at other times it was quite invisible. He watched its variation for some years, and then other astronomers took up the tale. Now we know that Mira—or the wonderful, as this variable star is called—goes through a whole cycle of light-changes in three hundred and thirty-two days. Up and down, up and down, down more slowly than up, it pulsates throughout the ages. Whence this rhythmic change of light? What cyclopean monster can be stoking the fires of this immense orb?

The question is of supreme interest, for there are over three hundred stars of the same type as Mira known to astronomers. But before we deal with the "why" of the variation of such stars, let us consider for a moment the manner and the character of their light-changes.

We have used the words "of the same type as Mira." What are the peculiar marks of this type? One is that with the great majority of these stars—stars like Mira—a full period of variation is completed in about one year; a second feature is that their color is always red; and yet a third feature is that their range of variation is very great and frequently irregular. Take, for instance, the star Mira. At its maximum brightness the light of this variable star is at least one thousand times greater than the amount of light it gives forth at its minimum phase. And Mira is not a solitary example of a range so considerable. There is in the southern sky a star whose increase in brightness from minimum to maximum is no less than ten thousandfold. Other similar instances could readily be brought forward.

Now, here we are face to face with a supreme difficulty. If Mira once or twice blazed up a thousandfold, and then, exhausted, went out in darkness, we could understand the phenomenon. We should be witnessing simply a celestial conflagration. But here we have a star (and, as we have said, there are hundreds of the same type) that periodically, with the regularity of the returning seasons, gets into a frenzy of light and heat, and is afterward apparently none the worse for its outbursts. At any rate, it has been going on in this extraordinary way, probably for ages, without anything happening that would indicate a final catastrophe.

Many explanations will at once arise in the mind; some of these can be set aside without argument. No part of the variation of stars of this type is caused by eclipse. The revolution of a body partly bright and partly dark is also out of the question. Imagine a star with one hemisphere one thousand times brighter than the other!

What about chemical change? Any chemical change which would produce an increase of light anything like that which takes place on Mira would mean also the disintegration of the star.

Perhaps the primal cause of the variation of the peculiar type that we find in Mira and its congeners has its origin in electrical disturbance similar to the rhythmical discharges which produce the aurora and perhaps also the sun's corona.

But it is as well to be honest in the matter, and to confess that we know next to nothing of the cause or causes which lie behind long-period variation. We know the effects, for we can see them, measure them, classify them; but that which lies behind the things seen is beyond our ken, at least with our present means of research. We must content ourselves with the visible facts of variation of the type of Mira and leave the question of cause to a future day.

The eighteenth century was well on to a close before the first star of the third type of variation was discovered. This third type is usually known as "short-period variation," just as stars belonging to the previous or second class are called "long-period variables." As the name indicates, stars belonging to the "short-period" class vary in a short period, usually a few days, sometimes a few hours. There is a southern variable, for instance, which completes its cycle of light-changes in seven hours. The range of variation in stars of this type is always small, and the period very regular.

One of the most important advances of late years in this branch of astronomy, sometimes called astrophysics, has been the discovery that many, if not all, of the stars of the short-period type are double—that is, each short-period variable is composed of two stars; and its variation is somehow connected with its binary character.

The thought at once arises that the variation is due naturally to the eclipse of one component by the other. The character, however, of the light-changes of stars of the third class indicates indubitably that their variation is not due to eclipse but to tidal action of some kind. Probably the revolution of one star round the other produces stellar tides; and these vast upheavals of liquid or gaseous matter generate sufficient heat to give to the light of the star a variable character. This is the explanation of short-period variation which most commends itself to those who follow out this special branch of astronomy, and it seems to the writer both an efficient and sufficient theory.

It may be said here that the stars belonging to this third class are fewer in number than those belonging to the second class, probably because their narrow range of variation makes them more difficult objects to discover. About one hundred are known to astronomers. This number, however, is steadily increasing as the accuracy with which observations of light-changes are made becomes improved.

Perhaps the most interesting class of variable stars is the fourth class—interesting because we know what causes their variation, and still more interesting because of the direction and the distance that this knowledge has already brought us.

Stars of the fourth class are more commonly called Algol variables, because of the famous star Algol, the first in point of discovery and first in importance of all stars of this type. It needs no refined appliances to obtain a great deal of knowledge concerning these stars, for Algol is bright enough to be seen by the naked eye, and even untrained vision can follow its light-changes. Every good almanac also duly sets forth the times and seasons of its eclipse. Almost every text-book in astronomy also declares the manner and nature of its light-changes, so that if any one is in ignorance of the behavior of an Algol star it is not through lack of opportunity of obtaining knowledge on the matter.

There is in almost all stars of this class a constant period during which the star remains invariable in brightness. Then sets in a period of rapidly-decreasing light, followed by an equally rapid rise to the star's normal brightness. No comparison occurs to me more illustrative of Algol variation than the winking, winking, winking light on some dangerous headland; only in the case of the lighthouse the obscuration takes place every minute and lasts one or two seconds, while in the case of an Algol variable the eclipse occurs every two or three days and lasts some hours. The eclipse! Here we have the secret of Algol variation. All stars of this class are double, and the sudden change in their brightness is caused by one coming in front of the other.

Modern astronomy has deduced a number of interesting conclusions from the manner in which stars of this class vary in brightness; or, to put the matter otherwise, from the way in which one of the companions of an Algol system shuts off all or part of the light of its fellow, we may arrive at a number of very important deductions. We may, for example, frequently determine the size of the two stars, their nearness to one another, their density, their weight, their shape. Consider what all this means; consider what a wide field of research it opens up. And, above all, there is this of interest circling round Algol stars: we are not dealing with old, decrepit, worn-out worlds and systems; we are dealing with worlds newly born. When we observe an Algol variable we are looking on a star in its cradle, for, astronomically speaking, it was only but yesterday that the system divided into the two stars which compose it. Indeed, with regard to three such stars, division has scarcely yet taken place, and the two masses are for all the world like two pears joined point to point.

We might add a fifth class of variable stars, and push into it every changing star that will not fall readily into line with one or other of the four distinctly marked types described in this paper. Into this class many observers would thrust the great bulk of stars; for not a few careful and cautious inquirers urge that almost every star in the sky is more or less variable.

But since the sun is also a star, what about its light? Is the brightness of the sun variable like that of the inconstant moon, though to an infinitely less marked extent? There is abundant evidence that the sun's light is not constant; and probably when we have got behind the secret of its variation we shall also have got behind the secret of droughts and blizzards and magnetic storms.

At the beginning of this paper we touched on the idea of the whole creation of stars passing through vast secular changes; but the conception of such a thought, not to speak of observations even remotely bearing on so profound a matter, is beyond our finite minds. At least we could only vaguely theorize on the subject, and that is not profitable.

It is exceedingly remarkable that the bulk of our knowledge of stellar variation has been gained for us by men with little means and less leisure. I do not think it is sufficiently known that no town can claim to its credit so great a number of variable stars as the old gray capital of Scotland. And the observer who has made all these discoveries has done so with a telescope as long as one's arm, and in an observatory the dome of which is a street window!

There is no section of modern astronomy which holds out more promise of success to the amateur observer than the subject of variable stars. A small telescope or even none (Heis, one of the greatest authorities on the subject, used his unaided eyes), a good star atlas (failing the possession of this, let the observer make one for himself), and an unpretentious

catalogue of stars are all that is needed to carry on the highest work and the most recondite research on variable stars.

THE PLANT OF THE NEW ELECTRIC RAILROAD UP MOUNT VESUVIUS.

By the English Correspondent of the SCIENTIFIC AMERICAN.

A NEW section of electric railroad has been constructed by Messrs. Cook & Son, Ltd., up Mount Vesuvius. The length of this track is only about 4¾ miles, connecting Pugliano with the terminus of the old rack-and-pinion railroad running from Resina to the cone of the Vesuvius crater.

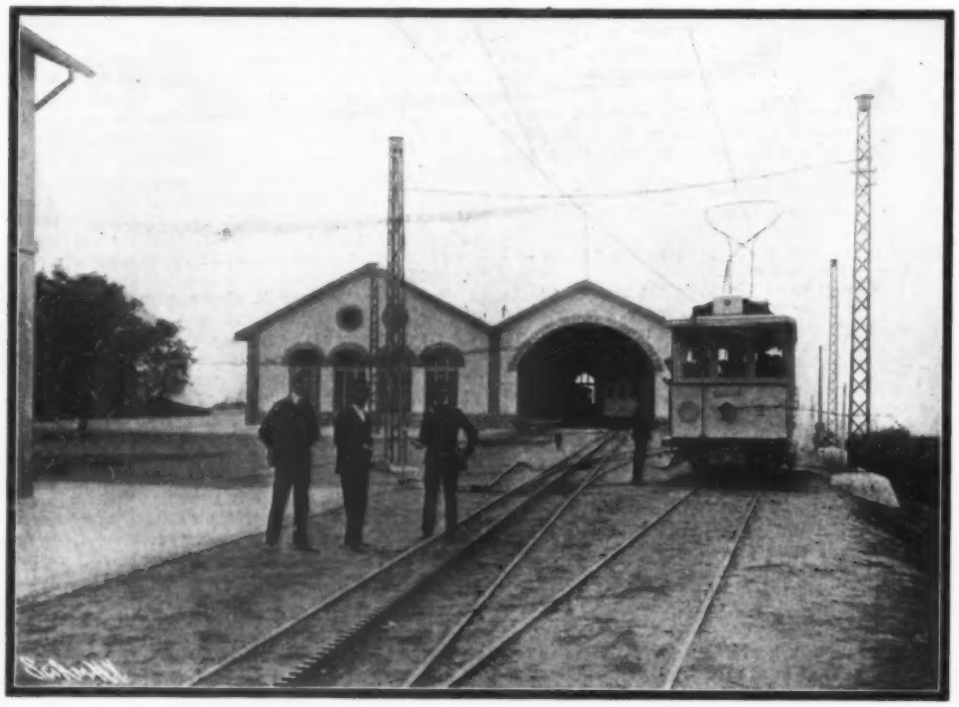
The system of driving is friction, as the gradient for the most part is only 1 in 12.5. There is a short section, however, in the center, where the gradient becomes so steep, being 1 in 4, that the Strub rack-rail system, identical with that utilized on the Jungfrau railroad, has had to be adopted.

Both the self-contained motor cars and the electric rack locomotive have been incorporated for propulsion, the latter system being intended for operation on the rack-rail section. Over this part of the track the locomotive pushes instead of hauling the cars. The generating station for the supply of the electrical power for the operation of this railroad is situated at the base of Monte Cateroni, in close proximity to the point where the section of the rack railroad commences. Gas engines are utilized for driving the electrical plant.

The electric installation of the power house comprises primarily two continuous-current shunt-wound dynamos, the particulars of each of which are as follows:

Normal power	90 H. P.
Speed	70 revs. per min.
Normal pressure	500 volts.
Maximum pressure	770 volts.
Maximum current at 550 volts	137 amperes.
Number of poles	4
Bore of magnet	1 ft., 10¼ in.
Diameter of armature	1 ft., 9½ in.
Diameter of pole	10 in.
Number of bars	510
Number of slots	85
Number of collector blades	255
Number of bearings	2
Principal dimensions:	
Length	7 ft., 2 in.
Width	4 ft.
Height	4 ft., 6 in.
Pulley:	
Diameter	2 ft., 3½ in.
Face	1 ft., 2¾ in.

Both the dynamos work in parallel with a battery of three hundred accumulators. The generators or dynamos, of the C. E. & L. Brown system, are built specially for traction purposes, that is to say, for cases in which use is made of a battery, but where no special dynamo is provided for charging the battery. The generators are, therefore, calculated so as to render possible an increase of pressure to 770 volts (corresponding to 300 × 2.57 volts) without its being necessary to increase the speed of the driving gas engines. The gas engines for driving the generators were supplied by the Schweizerische Lokomotiv und Maschinen Fabrik, of Winterthur, and are so constructed that their speed can be increased by about ten per cent, but it is sufficient to have them running at the normal speed.



VIEW OF THE POWER HOUSE AND CAR SHEDS.

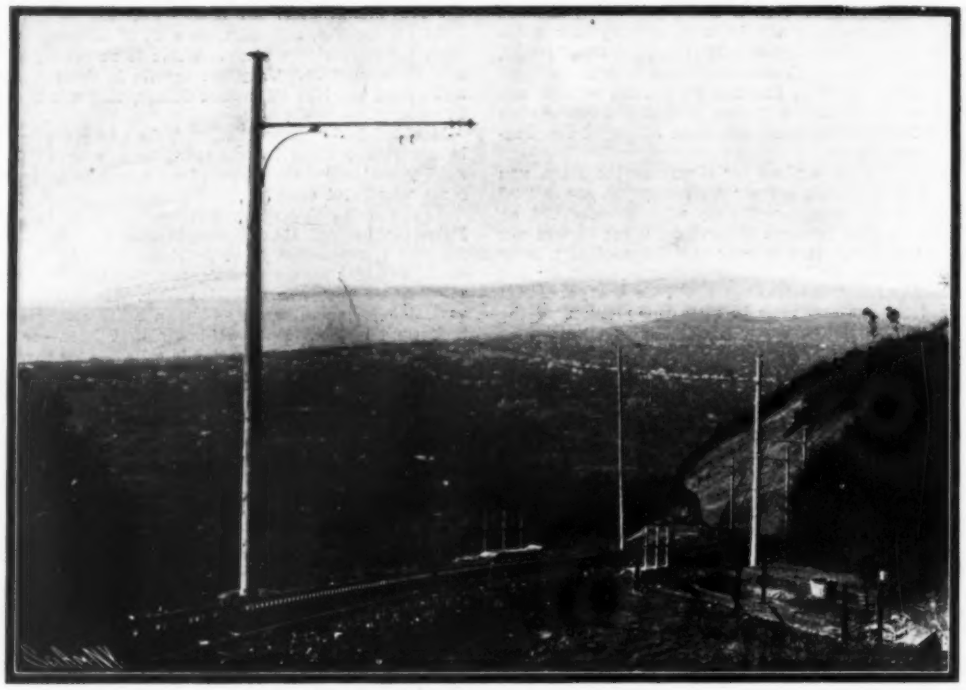
The current generated by the dynamos passes first through an automatic maximum and return-current switch (i. e., a switch with automatic release), then through a two-pole reversing switch which, according to its position, connects the dynamo with the line or with the storage battery.

For the purpose of starting the gas engines, the generator can be worked as a motor, current from the batteries being then utilized. To insure this end there is provided a special switch with resistance. The starting takes place with the maximum and return current switch open, and the shunt resistance short-circuited. The starting current is about 60 amperes, but this gradually decreases. When the current diminishes to zero, the automatic maximum and return current switch is closed, and the shunt resistance gradually switched in until the desired pressure is obtained. The starting of the gas engines can also be effected by means of compressed air.

The switchboard is divided into five panels, which, reading from left to right, are arranged as follows: One feeder panel, two generator panels, one empty panel intended to receive the connections from a third generator, to be put in later, and an accumulator panel.

The arrangement of the switchboard is such as to enable one generator to be connected to the line, while the other generator, with increased pressure, charges the accumulator battery, for which a special charging collector bar is provided. For the purpose of inspecting and examining the switchboard, the earth connection, i. e., connection to the rails, can be interrupted. The feeder field is arranged for three cables, each cable having an ammeter, a hand switch, and an automatic maximum release switch.

The accumulator battery, supplied by the Fabbrica Nazionale di Accumulatori brevetto Tudor, in Genoa, consists of three hundred cells in glass jars, with guaranteed capacity of 256 ampere-hours at a discharge current of 256 amperes. The average charging current is 128 amperes, and the maximum which can be permitted in cases of extreme emergency, 140 amperes. The power house is electrically lighted by means of ten incandescent lamps, arranged in two groups of five connected in series.



SECTION OF ROAD LOOKING UPON NAPLES.

The line wire is divided at the central station, by means of a section insulator, into two sections, that is to say, the Central Station to Pugliano (the commencement of the railroad), and from the Central to the old rack (end of the railroad). The third cable, starting from the switchboard, was originally intended to form a feeder line for the section from the Central Station to the Funicular, or to drive the motor for the funicular railroad. As, however, it has been found possible to dispense with this feeder line, its construction has not been proceeded with. The two tracks in the car-sheds are also provided with a contact wire which, however, can be switched out of circuit by means of its special switch. At the upper end of the toothed rack section, near the Observatory, is arranged a section insulator, by means of which the line from the Central Station to the Funicular is divided into two sections. In this way it will be possible to disconnect the Observatory-Funicular section, that is the most liable to be damaged by any eruptions of Mount Vesuvius, without necessitating the cutting out of the toothed rack portion and the shed tracks and side tracks at the Central Station connected with it. This section insulator is mounted in an easily accessible manner in a protective casing on one of the posts.

We may mention here also that lightning arresters and devices for stretching the wires of the line are provided. The arresters are arranged at 6-10 mile intervals, and are the so-called Wurts lightning conductors mounted on the line posts. The ground wire is mounted upon the post in wooden conduits, and connected to the rails which form the ground plate. Stretching devices are arranged at intervals of 1,640 feet, and are intended to enable the trolley wires to be stretched or loosened as desired, thus equalizing the sagging. These wires are suspended from long brackets, which extend from the poles, as shown. As the current is collected by means of wire loops instead of by trolley wheels, the wires are arranged in a zig-zag form, so as to attain uniform wearing of the contact parts.

Having regard to the high temperatures which are very common in this region, the suspension of the line wire is effected on insulators with vulcanized rubber insulation. The supply line wire is 1 × 8 millimeters on the Central Station-Pugliano and Observatory-Funicular section, and 2 × 8 millimeter wires on the rack portion, Central Station-Observatory. The maximum loss of pressure in the line wires approximates a voltage of twenty-five per cent of the potential.

For transmitting service signals and orders, there has been installed along the whole railroad a two-wire telephone line and a single-wire telegraph line, with stations at the termini of the railway, at the Observatory, and at the Central Station. These wires are suspended on the line posts on porcelain insulators.

The return current is carried through the rails. The Brown-Boveri system of metal paste bonding has been adopted. This process consists of covering the thoroughly cleaned and scraped contact surfaces of the fishplates and ends of the rails with a metal paste which is an excellent conductor of electricity. In order to utilize both the tracks for the return of the current, there are provided, at intervals of 328 feet, cross-connections of 0.314-inch diameter copper wires having lugs soldered on for screwing to the rails. At the crossovers and switches, where it would have been

difficult to effect proper bonding by means of a metal paste, special wires are provided for this purpose.

The motor cars have seating accommodation for 24 passengers. Six more can be carried on the platforms, thereby making a total complement of 30 passengers per vehicle.

TRAIN ON THE RACK SECTION OF MOUNT VESUVIUS RAILWAY.

The current is collected by the motor cars from the line wires by means of a wire loop (aluminium contact); it passes through the induction coil, the hand and automatic maximum switches, fuse, and then through the controller and starting resistances, to the motors, and finally to the rails, which act as a return. There are three positions of the controller lever for driving with both motors in series, and five for running with them in parallel. The speed of a fully loaded car for the different gradients at the terminal pressure of 500 volts is as follows:

Gradient per cent.....	0	1	2	3	4	5	6	7	8
Speed, kilom. per hour	15	14.1	13.7	13.3	12.9	12.5	12.1	11.7	11.3

Taking into consideration the gradient and omitting the stoppages at the intermediate stations, the times occupied in traveling are:

Pugliano-Central Station.....15.5 minutes
Observatory-Central Station.....14 minutes

In the electric equipment of the locomotive, the current is collected from the line wire by means of two sliding contacts, and passes first through the induction coil, then through the automatic reversing switch, the ammeter, the solenoid or coil for the automatic reversing switch (which solenoid operates, in the event of an excessive current or of a short circuit, the automatic reversing switch and at the same time releases the emergency brake), the controller with its starting resistance, and thence through the motors to the rails. The shunt resistance can be used for speed-regulating purposes, but as a rule it is not varied, but set once and for all. The particulars of each of the two motors which are switched in series are as follows:

Normal power per motor	85 h. p.
Pressure per motor	250 volts
Revolutions per minute	700
Number of poles	4
Bore of magnets	1 ft. 6¼ in.
Diameter of armature	1 ft. 5½ in.
Diameter of pole	9¼ in.
Number of bars	210
Number of slots	53
Number of collector blades	105
Number of bearings	2

Each locomotive is lighted by six incandescent electric lamps.

The collecting shoe or contact itself comprises a triangular pressed brass tube, the ends of which, however, are round, and are carried on pivots on the frame of the contact tube, enabling it thereby to revolve. In this way the current is collected, not simply at one point, but throughout the surface of a length of about one inch, a perfect contact thus being insured, and all sparking avoided. As an additional precaution, each locomotive is provided with two contacts.

During the descent the motors are switched over and act as generators, the energy thus produced being absorbed by the accumulators.

The experiments carried out with the brakes have proved the excellence of the system adopted—the so-called automatic reversion type. Owing to the fact that when the speed brake is acting, the motors brake first and the band brakes are applied only subsequently after the speed has already been reduced to a considerable extent, the stopping takes place very smoothly, so that any accidental lifting of the locomotive on the toothed rack is prevented, even without taking into consideration the existence of the safety pincers.

The construction of this road, together with the remodeling and electrification of the funicular railroad, and the building of the electric railroad connecting Naples with Pugliano, which is almost completed, will afford a direct and through communication from the former town to a point 250 yards from the crater. The journey will also be more expeditious, comfortable, and easier than any of the existing or former means of transit up Mount Vesuvius.

GROWTH OF THE USE OF INCANDESCENT GAS.

MR. NEWBIGGING, chief engineer of the Manchester municipally-owned gasworks, in a paper read recently before an association of students of civil engineering, said that the introduction of the incandescent gas-burner had given a new lease of life to gas undertakings, and had placed gas in the front position as the cheapest illuminant. While he did not deny that, for decorative effects, electricity had advantages over gas, he thought the recent introduction of the inverted incandescent gas-burner bade fair to rival the present incandescent electric light. Having made the statement that electricity, light for light at Manchester prices, is eight times dearer than gas, he said an incandescent gas-burner develops per cubic foot of gas consumed, from 15 to 40 candles, according to the system employed. With gas at 2s. 4d. (56 cents) per 1,000 cubic feet and electricity at 3.86d. (7.72 cents) per unit, average prices in Manchester, and taking the lowest power developed by the incandescent gas-burner, viz., 15 candles per cubic foot, 15,000 candles per 1,000 cubic feet, the cost would be 1.86d. (3.72 cents) for 1,000 candles, while one unit of electricity developed in "an incandescent burner," a light equal to 256 candles each at 3.86d. (7.72 cents) per unit, or 15.05d. (30.10 cents) per 1,000 candles.

The Manchester gasworks intends to establish a new department to deal not only with the maintenance of consumers' incandescent burners, but to assist in developing the greatest amount of light from the gas consumed.

There has been very great prejudice in England against the use of carbureted water-gas, the kind in most extensive use in the United States. After describing the manufacture of coal gas and of carbureted water-gas, Mr. Newbigging said that in regard to the latter much unwarrantable public agitation had been directed against its distribution in England. As a matter of fact, carbureted water-gas was purer than coal gas, and had the same characteristic odor. It has been manufactured in Manchester for the past seven years, and there has not been a single accident caused through its use.

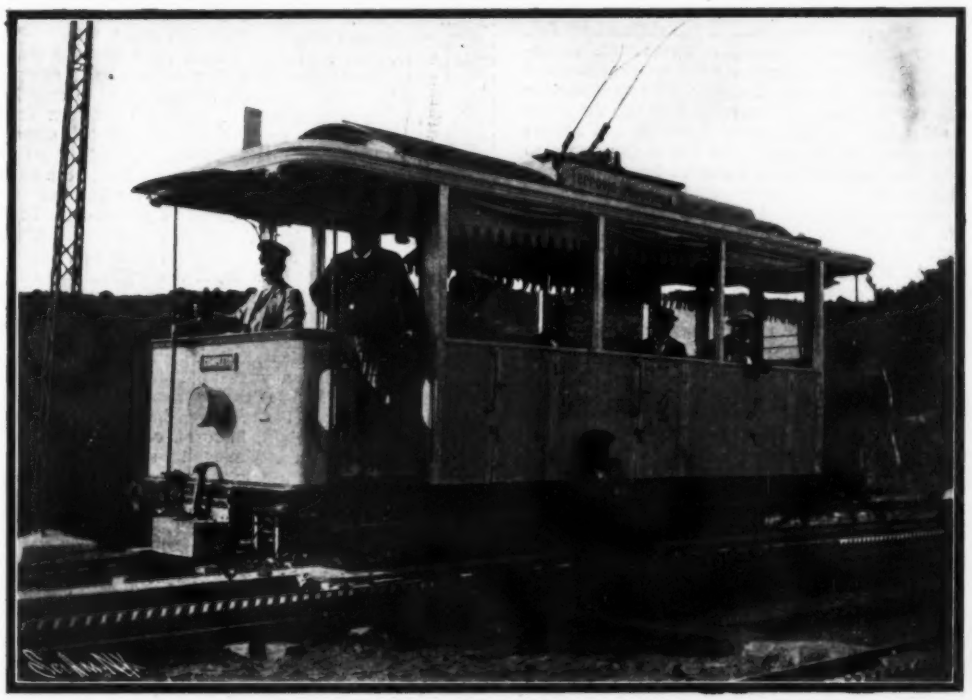
An abstract of Mr. Newbigging's paper was published in a recent number of the Gas World, and in the same issue of that publication I find in the speeches of the chairmen at the half-yearly meetings of two gas companies a number of interesting bits of information regarding gas.

Sir George Livesy told the shareholders of the South Metropolitan Gas Company of London that because there were 1,063 additional ordinary consumers, 17,055 more penny-in-the-slot gas consumers, 3,654 more cooking stoves in use by ordinary householders, 18,865 more cooking stoves in use by penny-in-the-slot gas consumers, and many more customers using gas engines and gas fires, the management had come to the conclusion that the increased consumption should be something like 270,000,000 cubic feet of gas, but there had been an increase of only 170,000,000 cubic feet. He said, in explanation, that the falling off in the expected increase was fully accounted for by the free adoption of the incandescent mantle. In one factory it was found on test that with incandescent burners the consumption of gas was one-third less than it had been with the best flat-flame burners, while the light was greatly superior. There was no doubt that the incandescent burner was being largely adopted. The company had forty-five men devoting their attention to the wants of customers in the matter of maintenance of mantles, etc., of incandescent lamps, while many consumers had learned to do the work for themselves. It was found that the adoption of the mantle meant a reduction of 35 per cent in the consumption of gas, and to Sir George the wonder was that with the largely increased use of the mantle there had been any increase in the consumption at all.

The gentleman who seconded the motion for the adoption of the report said that the automatic meter (penny-in-the-slot) consumers had, in the last five years, increased in number by 81 per cent, the stoves used by them by 100 per cent, and the stoves used by ordinary consumers by 50 per cent; and though the quantity of gas made was so much greater, the company used less coal, owing no doubt to improved methods of manufacture.—Marshal Halstead, U. S. Consul, Birmingham, England.

TURKISH PREPARATIONS FROM GRAPE JUICE.

IN Turkey considerable attention is devoted to the preparation of various articles from grape juice which are used as comestibles and are put up in a very convenient form for use when traveling. These are as follows: "Hasduk," in the manufacture of which freshly-expressed grape juice is evaporated down to the consistency of molasses—a considerable amount of flour or starch is mingled with it and the mixture is spread in thin sheets upon cotton cloth and exposed for two days in the sunshine. After drying, these are then removed from the cotton (a damp cloth being applied to the reverse side in order to loosen the sheets), and for three months they are preserved in tightly closed jars.



ELECTRIC MOTOR CAR ON THE MOUNT VESUVIUS RAILWAY.

After this period there seems to be no risk of decomposition in the product, which resembles leather in pliability and appearance, the color being that of the grapes employed at the outset. "Kesme" is another preparation which differs from the preceding in that coarse wheat grits are employed instead of flour and starch, and the resultant product is obtained in cakes half an inch thick, after drying on metal plates. It is less tough than the "basduk" and more savory. In the preparation of "sujuk" (*rojik* in Armenian), walnuts are strung closely together on pieces of stout twine a yard long. These strings are immersed in the mixture of grape molasses and flour described above, and after receiving a coating about one-fourth of an inch in thickness are withdrawn and hung up to dry. The last two are preserved for a few months in jars, as in the case of the "basduk." These three preparations are said to be excellent articles of food, the last two being especially savory. They offer much nutriment in a compact form, and are exceptionally well adapted for the needs of the Oriental traveler.

THE MAN AND THE SHIP.*

By GEORGE W. DICKIE, President of the Technical Society of the Pacific Coast.

I HAVE decided to give this lecture under the general title of "The Man and the Ship," first, because my friends usually ask me to do so, and second, because I think the Pacific coast needs good men and the Pacific Ocean good ships.

The grandest development in men and ships will, I think, mark the beginning of the twentieth century for its epoch, and the Pacific for its stage.

In this lecture, however, I am not to deal with any pictures of future developments, either in men or in ships, but rather to indulge in some reflections that have often occupied my mind while striving to accomplish two very important tasks—that of building good ships that will stand the "battle and the breeze," and building for myself a character that will carry me through the storm and stress of life's struggle.

We will inquire how these two things can go together. It needs a shipbuilder to understand how one-half of this subject can match the other, so I will have to ask my audience to trust me for the shipbuilder's half. As to the other half—that is, the man—you can take him for just what you think he is worth, only he goes with the ship.

By a man I desire to be understood as meaning a whole man, complete in every particular. Not a male man or a female man, but the combination of both, is my understanding of a man; and my ship is to be a first-class ship of the line, which ordinarily is referred to in the feminine gender, as she or her, and yet she is a man-of-war.

The difference between man and woman, as we find them in society, and what might correspond to them in ships, has, by a process of evolution going on in our time, become rather faint, and, in some advanced cases, scarcely distinguishable.

Not so very long ago, in naval ship society, the frigate was a consort to the man-of-war, and these two were "useless each without the other." The power of the frigate lay in maneuvering and in speed; she could always outsail the man-of-war, just as the woman can outsail and maneuver all around a man. She, the frigate, was built on finer lines than the man-of-war, full and buoyant in the breasts, with a fine midship section, and gracefully rounded buttocks. These were desirable qualities in the frigate; and what a power she had to carry canvas! A frigate of the first class, under full sail, was a sight that never failed to stir the heart of an old man-of-war's man; and has it not always been the ambition of every man worth the name to have his consort carry all the canvas he could afford to deck her in?

But times have changed with frigates and with women. The old-time frigate has become a cruiser. Her rounded breast lines have taken the form of a wedge, with a torpedo tube in the edge of it; the fine midship section has been swelled out to hold boilers and coal bunkers; propeller wheels have taken the place of the great swelling sails, and the gracefully rounded buttocks have given place to the sharp stern line, so that there may be no eddies to affect the action of the wheels.

Like the old frigate, the modern woman has also become a cruiser, and she no longer plays a second part to her consort of the line. Her ability to carry canvas, owing to her new design, has been very much reduced, and those fitted with propeller wheels have had to dispense with all superfluous canvas, clew up the lower courses, and, where the channels are clear and there are no obstructions to navigation, they may be seen on fine days making good time with their wheels under bare poles.

With this much by way of introduction, it is my purpose in this lecture to compare the chief characteristics of a first-class man and a first-class man-of-war, and in this comparison I shall divide the subject into two sections, each having a group of characteristics which can be compared with each other.

The first group will be of qualities inherent in the design of the battleship—qualities which cannot be altered, but which may be modified by acquired qualities in her equipment corresponding to a group of inherent qualities in the man; those characteristics which were born with him, and which he retains through life, subject to modification by education and experience, but never to be entirely eliminated.

* Read before the Association of Engineering Societies, March 8, 1905.

The second group will be the fighting and endurance qualities given to the battleship, represented by her propelling power; how long the source of this power will last; her means of offense and of defense, and the personnel of her complement.

In the man, this group of qualities is represented by education, power of will, industry, regard for truth and right, and faithfulness to duty.

The naval architect, in beginning his design for a first-class battleship, or for any other form of ship, must, like the architect of a building, decide first on the foundation. As the size and weight of the building determine the character and extent of the foundation required, so the size and weight of the battleship determine not the character of the foundation, for that is always the same, but the amount of foundation.

On a foundation of piles and concrete on the lake front of the Columbian Exhibition, at Chicago, there was a full-sized model of a battleship built of brick and mortar; but such a deception was possible only on a lake where the water is always on the same level. The foundation was not a ship foundation at all.

The naval architect calls his foundation "displacement," and his unit of measurement for his foundation is 35 cubic feet, because that volume of sea water weighs one long ton

In order that what I have to say in regard to my battleship may have a definite meaning, I shall take the qualities of the battleship "Oregon" as standard in this lecture.

The very first question the designer had to answer was, "How deep shall my foundation be?" The depths of certain docks and harbors must be considered in reaching a decision, and, knowing where the vessel had to go, this was fixed at 24 feet. This depth of foundation must therefore carry the structure he is to build.

Having this important point settled, he must now get information from other experts; so he calls on the engineer for the weight of all the machinery the foundation must carry; on the ordnance expert for the weight of all the armor, guns, and ammunition the foundation must carry for him; on the equipment expert for the weight of all the outfit the foundation must carry for him; and then he figures out very carefully the weight of the structure itself, after which the experts must meet and decide how much weight of coal and stores and people must also be carried by the foundation. After which the whole is summed up, and the result is that the foundation must carry 10,400 tons.

He must now consider how wide his foundation will be. The positions of the weights that he has to carry, above the base line of the foundation, help him to determine this dimension. Here, also, he consults all the gathered experience of his profession with the type of ship nearest to the proposed design, the result being that he decides on a width of 69 feet.

Now, if he had to build simply a rectangular structure, the weight of which was 10,400 tons, he would find that, at 35 cubic feet to the ton, the contents of the foundation would be 364,000 cubic feet; and, the depth having been settled at 24 feet, and the width at 69 feet, the length would therefore be 220 feet. This would be the smallest dimension of foundation that would carry the load, and it is called the box displacement; that is, a box 24 feet deep, 69 feet wide, and 220 feet long, if filled completely full would contain 10,400 tons of sea water.

Here a great many considerations present themselves to the designer. He knows that an increase in the length would give him fine lines and speed, with moderate power, but would detract from other qualities that a battleship should possess; and, speed not being everything in a battleship, he again has recourse to experience, and this tells him that the ratio between the length of his battleship and that of a box must be somewhere between 1 to 0.6 and 1 to 0.65. So he decides on 0.631, and this makes the length of our battleship 348 feet. This ratio between that part of the ship which is in the water and a box is called in America the box coefficient, and in England the coefficient of fineness.

On this foundation of displacement rests our battleship, and it is absolutely sure, if the weights are correct; but, if the weight exceeds by any amount the designer's figures, the foundation gives way correspondingly. The designer, therefore, must be sure of his weights, of his dimensions, and of his coefficient of fineness, or his foundation will fail him. His ship will displace not an inch more than is provided for by the form and dimensions he has given her. If he makes an error either in weight, in form, or in dimensions, some other desired quality must be sacrificed.

A man, like a battleship, is supported by his own displacement; and, if he is to hold his own in the battle of life, with freeboard enough for winter weather, he must have a high box coefficient. His only foundation on the sea of life is his power of displacement. A man, when launched into the world, finds no empty place made ready to receive him. No one scoops out a hole in the water to receive the ship; when launched she must displace her weight of the element into which she plunges. So a man displaces his weight of whatever element is opposed to him.

This law is as true of him as of a battleship, with only this difference: that the ship displaces but one thing, and by that she is supported; but man's power of displacement has no limit in kind, and in degree it is limited only by the bulk of the man.

What we, as individuals, are displacing is the coefficient of our power for good or evil on this earth. What we, as a community or nation, are displacing will be the coefficient of the power for good or evil of that nation on the human race.

In our designs for manhood, let our box coefficient, be it great or small, stand for the displacement of wrong by right; or of error by truth; of ignorance by knowledge; of idleness by work; of dead things by living things; of weakness by strength; of sorrow by joy, and of all evil things by things that are good. We must not forget that our power to do good in this world is simply our power to displace evil by the coefficient of our own goodness.

The displacement of the man, like that of the ship, is his foundation; that is, his character.

Having determined the amount and dimensions of the foundation that is to support the man-of-war, the naval architect must now deal with another quality—that of stability. Here a somewhat more complicated set of problems confronts the designer.

In a building, the more stability the architect can secure the better; but in a man-of-war, too much stability would be quite as undesirable as too little. It is therefore the business of the naval architect so to work out his design that the proper amount of stability will be attained.

Stability and steadiness do not always go together in a ship; in fact, they are sometimes quite opposite qualities. To secure steadiness, stability must be present; yet a ship may have a high stability, and, notwithstanding (in fact, *because* of extra stability), may be a very unsteady ship.

The stability of our man-of-war depends upon the positions, relative to each other, of two points; of these, one is the center of motion, the other the center of mass. The architect calls one the metacenter, and the other the center of gravity, and he expresses the stability of his design for a ship by the sign of an M above a G, and the distance between these points he expresses in feet and inches.

The metacenter is the point around which the ship moves in rolling. If only the seasick unfortunate could find that point he might there find relief. The naval architect finds it by taking the center of buoyancy of each of the sections he has made of his ship, and therefrom finding a mean center of buoyancy. The metacenter will always lie in a longitudinal vertical plane, bisecting the ship, and vertically over the center of buoyancy, and its position is found by dividing the moment of inertia of the load water plane, relative to the middle of the vessel, by the volume of displacement; that is, by the amount of foundation.

I do not expect you to understand this; it is not at all necessary that you should. So long as the naval architect understands it, you will be perfectly safe in taking his word for it.

The captain, who is to command this man-of-war, does not know, perhaps, how to find this important point in his ship; but the way in which she behaves herself at sea will soon enable him to determine whether it is in the right place or not.

Then the center of gravity must be carefully determined by the designer; and to do this he draws a line under the keel, and this he calls the base line; and, having found the position of the metacenter, he notes it as so many feet above the base line. Now he begins a series of computations in regard to the weight of every part of the ship; nothing must be left out. He also finds the center of gravity of every piece, and its height above the base line. He expresses the weight of every piece in tons, and its height above the base line in feet. He multiplies these two factors by each other, and expresses the result in foot-tons; and this is termed the moment of leverage of that particular piece.

Having thus determined the weight and leverage of every part, the total amount or foot-tons, divided by the displacement or foundation weight, will give the height of the center of gravity above the base line.

I do not expect you to understand this either, and it is not necessary, but the naval architect must understand it very thoroughly, or the result may be very serious, indeed.

The stability, then, of a man-of-war, or of any other ship, depends upon how much the M is above the G in her design. If they were both in one place there would be no initial stability, and the ship would remain in any position that she might accidentally get into; and if G were above M she would turn bottom side up.

This is initial stability, and it is an inherent quality in the design of the ship. It may be modified, after the ship is built, by taking in weights below, if G is too high, or by putting weights above, if G is too low; but the necessity for such corrections always reflects on the skill of the designer.

Now, initial stability is an inherent quality in the man, and without it he is a helpless hulk on the sea of life. His metacenter, like that of the ship, is the point around which he swings, the center of his affections. His center of gravity, the weight of those things that he carries about with him, must be kept well below the center of his affections, else there will be nothing stable about him. If his box coefficient be high, and his dimensions large, he may carry great weights of this world's goods. So long as their moment of leverage is not too great, and their combined center of influence is kept well below the metacenter, their effect may be beneficial, making him more comfortable at sea. So long as our earthly possessions, real estate, cash accounts, and other heavy things are carried in the lower 'tween decks, with a good metacentric height, our stability will be improved, and not impaired, by the load we carry. So long as we keep M well above G in all the vital matters of our life, we may safely put to sea with everything on board.

Through ignorance of the laws that govern the stability of a ship, those in charge of her often stow weights on board in such a position as to endanger her stability, going to sea only to meet disaster.

So a man often takes into his life things that he cannot carry. Let us be careful that those things do not lower our metacenter. Far better throw such weights overboard than struggle at sea without stability. So let us set our affections, that is our *M*, well above *G*.

A man-of-war or any other ship may have a large amount of initial stability, and yet be very unsteady at sea. If the ship is intended for river or harbor navigation, and is never to encounter rough water, then the more stability the better; but when amid waves, if the metacenter be too far above the center of gravity, the tendency to assume an upright position may be too great, and violent rolling may be the result.

In designing a man-of-war, great value is placed upon steadiness of platform; for, if that cannot be secured, she might have to fight under sea conditions which would give her opponent, if a steadier ship, a fatal advantage.

So the naval architect tries the design he has made, in order to see whether her righting moment is sufficient and not too great. When he inclines or heels his design, relative to the normal water plane, he finds that the sections show that on the one side a wedge-shaped piece goes down into the water, while another wedge-shaped piece comes out of the water on the other side. These two wedges are called the wedge of immersion and the wedge of emersion. Now, if these two wedges were equal, the ship, when thrown out of the upright position by waves, would not come back again. But, if the wedge that goes in is greater than the wedge that comes out, the difference is called the righting moment, or power of shoulder, and if this is very great, the ship, when thrown out of the upright position by waves, would come back too quickly, and would have an unsteady and violent rolling motion in a seaway.

So the skillful architect will so modify his sections above the normal water line that the wedge going in will not be too much in excess of that coming out, and he will thus secure easy motion in rough water.

This question of steadiness receives careful attention in the designs for a warship, because the weights to be carried are all known, and their positions are fixed in the design. The water line also is known, and it changes only with the consumption of fuel. But in a merchant ship, the designer has not so full control over the quality of steadiness, as a great range must be provided for in the position of the water line, and consequently much of the sea steadiness of such a ship will depend upon a skillful distribution of the cargo.

A man, like a ship, may have inherently great stability of character; his metacenter may be far above his center of gravity. In all ordinary conditions of life, he maintains an upright position, and, if smooth water prevail all through his life experience, his character will be admired, and others will point to him as a fine example of uprightness and stability. But let him get out into the open sea, amid the storms of life, where waves are high and great forces oppose themselves to him and his ways. It is then that his stability often degenerates into mere stubbornness; his righting moment is too great. Instead of rolling gently to the irresistible waves that beset him, and swinging gracefully back again to the upright position, when the wave has spent its force, he gathers all the power of his stability to fight against the natural forces around him, shipping huge seas in his desperate efforts to maintain his upright position; and, should the storm continue, he is apt to go down, a martyr to his own faith in inherent stability, to his sense of right.

As the naval architect tumbles the high wall sides of his ship home—that is, inside the perpendicular—to reduce the righting moment, and thus make her steady amid waves, so the man out at sea, when the storms gather about him, will find safety and comfort in tumbling home; there his rolling will be easier, and there he will have a steadier platform from which to fight his enemies.

Along with steadiness in rough water, the naval architect must so design his ship as to secure great *range* of stability; that is, he must maintain a righting moment sufficient to bring his ship back again, should she by some unusual force or combination of forces be forced far out of the upright position (and he generally constructs a curve or diagram that shows how far his ship can roll, and yet retain the power to recover her normal position).

In a man, I think that range of stability is a better and more desirable quality than initial stability without the power to recover a lost position when once driven from it. The man who, when beaten down and almost overwhelmed by opposing forces, still has this righting power intact—that principle within him that tends for righteousness—this man comes triumphantly through the struggle of life, while another, with greater initial stability, but with little range of righting power, might be utterly undone.

Having thus settled the matters pertaining to the hydraulic and statical questions that affect both a man and a man-of-war, the naval architect must then determine on the best possible use he can make of the weights allowed him for the hull proper. His skill in doing so determines the structural strength of the ship.

In a man-of-war or line-of-battle ship, a very large proportion of the displacement, which, as we have seen, is the foundation or support, is given up to carry heavy armor for defense, and a powerful battery for offense; so that, of the total displacement, just about one-third is available for the hull structure itself. Great skill is therefore necessary in making a proper disposal of the material forming the hull. The usual method of framing, adopted on a merchant ship, where simplicity and cheapness of construction are considered first, does not apply in a man-of-war. Here the material is disposed relative to the strains, and so that its strength will be utilized to the fullest extent; and certain dangers to the life of a battleship, such as a shot under the water line in some unprotected part, or a torpedo attack, must be provided for by many water-tight compartments, and by a double skin. There must also be special structural provision to carry the armor, and to receive the mounts of great guns; so that the hull of a man-of-war must be able not only to withstand the complicated strains due to the movement of the ship in a seaway, but must also support great weights of armor, and the shocks due to the firing of great guns. Much of our battleship's efficiency, therefore, depends upon her structural strength.

The man, like the ship, depends very much on structural strength. If he does not start out with a sound body, which is the hull that must carry all his means of offense and defense, he is apt to be worsted in the struggle of life. A good constitution for the man is, to him, what structural strength is to the man-of-war; and, if he starts in life with such a precious possession, he must be careful to preserve it.

The hull of the man-of-war, built, as it is, on the cellular principle, will deteriorate very rapidly if not properly cared for. Every part must be cleaned and painted frequently, to prevent corrosion and consequent waste. The naval architect may have provided a perfect structure, to begin with, but want of care may render all his wise provisions valueless.

The man, like the ship, is also constructed on the cellular principle. Men of science now tell us that he has grown, by a process of evolution, from a single simple cell to his present complicated structure of living cells, and it requires the greatest care on his part to preserve this wonderfully complicated cellular structure in order. His equipment may be first-class in every respect; he may have a powerful battery of all kinds of knowledge; but he cannot successfully carry it into the battle of life if he has neglected to care for his hull. If dirt has been allowed to accumulate in the bilges and double bottom of his life, corroding the whole structure of his manhood, then, when the day of battle comes, he will not be able to carry his battery into action; and that not because of any original defect or structural weakness, but because he neglected to obey the rules of the service, which require him to see to it that no part of his hull suffers from waste, other than that due to fair wear and tear.

A ship of imperfect construction, where an unskillful distribution of the material has been made, resulting either in loss of strength, or in the carrying of useless weight, may, by being well cared for, and never overloaded, outlive another ship, constructed with the utmost skill, where every pound of material has been located in its proper place, but where neglect has undone all the skill of the architect.

So a man may start in life with a defective construction of hull, his structural material poorly disposed for effective work; yet by care and good management he may outlive, and do better and more effective work than, another man who starts with a perfectly constructed hull, where every part is proportioned to its work, but where neglect, as in the case of the ship, has undone all the skill of the architect. Constant care of the structure is the price of safety in the man and in the ship.

(To be continued.)

WORKINGMEN'S INSURANCE IN GERMANY.

THERE is perhaps no country in the world where workmen are so protected by the state or are so cared for as in Germany. Even clerks, shop assistants, and servants are compelled to insure. This insurance is effected by pasting into a book certain stamps every week, and it is the duty of every employer to see that this is faithfully done.

In the German empire there are three insurances for workmen, all of which are obligatory and under the authority of the Imperial Insurance Office, viz.: Sickness, accident, old age, or infirmity. This insurance is mutual, and its administration autonomous under State control. It embraces without distinction of nationality, all persons working in Germany.

Sickness.—Insurance against sickness is especially for those occupied in industry and commerce receiving a yearly salary of $480 or more; but the law allows other workmen, comprising domestic servants, voluntarily to take advantage of it. It has 22,672 local offices, and 9,500,000 workmen get the yearly benefit of $36,500,000. The object of this insurance is to guarantee to the insured a sure and efficacious aid for at least thirteen weeks from the beginning of sickness.

The minimum advantages to which all insured have a right are:

1. The free services of a physician of the local bureau, or, in case of urgency, of any physician.
2. In case of inability to work, daily assistance (50 per cent. of daily salary), beginning from the third day of sickness, or the gratuitous services of a hospital with 25 per cent of the daily salary given to the family.
3. In case of death, funeral expenses equal to twenty times the daily salary.
4. Four weeks' gratuitous aid in childbirth.
5. Double insurance to any one paying double.
6. Any one falling sick in a locality outside his own is cared for by that locality, the expenses being reimbursed by the home locality.
7. No sick persons, whoever they are, can be excluded from their insurance rights.
8. When disability still exists at the end of thirteen weeks, the sick have a right to another thirteen weeks of gratuitous medical service before benefiting by the law for the disabled.

In 1898 there were 3,276,500 German workmen insured against sickness, the gratuitous services to whom amounted to over $33,000,000, while the expense of administration cost only $1,973,232.

No sickness is excluded from the benefit of insurance. If the sickness or disability is due to a row, or fight, money, but not medical aid, can be refused.

The law limits the assessment of members for communal insurance against sickness to from 1 to 1.33 per cent of the average earnings of an ordinary workman, and from 2 to 3 per cent for other bureaus. It also compels the employers to pay a supplement of one-half of what his employes pay. Two-thirds of the assessments are therefore furnished by the workmen and one-third by the employers. The bureaus of all insurance against sickness are administered by those interested, the employers and employes, under the direction of the local authorities.

Accident.—Workmen in the industries and in agriculture, etc., farmers, renters, day workmen, etc., gaining less than $482, must insure against accident. In certain cases those gaining more than $482 are allowed, and sometimes compelled to insure. A complementary law insures soldiers against accident, and the aid to all the employed in the Empire embraced in the insurance law against accident, is in the form of State pensions. This insurance is an employers' mutual insurance with a State guaranty, and its bureaus have a civil personality with complete administrative independence.

Every one insured in case of accident during work at a wage has right to gratuitous medical treatment. If the wounded is not insured against sickness, the owner of the establishment in which he is employed must accord to him from his private purse the same treatment he would have received from the bureau of insurance against sickness had he been insured therein. If the wounded is also insured against sickness, his pecuniary aid can amount to two-thirds of his wages. Builders and farm and forest workmen are treated for the first thirteen weeks at the expense of the commune in which the accident occurred. To prevent the necessity of paying a pension of disability the accident insurance bureaus are authorized, whenever it seems that the bureaus of insurance against sickness are unable to furnish the necessary assistance, to take the treatment of the patient in charge. These bureaus are not compelled to indemnify the wounded, but in some cases they can allow pecuniary aid. Gratuitous care in a hospital, beginning with the fourteenth week, can replace the expense of treatment and provisional pension. The admission to a hospital comprises gratuitous attendance, the expense of going and returning, and clothing, and during the treatment, an indemnity to the family of the victim, to which indemnity a wife, though married after the accident, has a right.

Accident insurance pensions are not calculated according to the personal gain of the victim, but according to the average wages fixed by age and sex. The amount paid in by employers is not determined by the number of workmen employed, but by their direct taxes. Small proprietors can be exempted, totally or partially, from any dues.

Perhaps one or two examples would show more clearly the work of German accident insurance:

A mason, married, earning $305, falls from a scaffolding, breaking his leg. The first three months he is looked after and all expenses paid by the bureau of insurance against sickness. Beginning with the ninety-first day he is treated for ninety days more in the hospital at the expense ($75) of the bureau of accident insurance. His family, a wife and two children, are paid $38. If at the end of twenty-six weeks he is totally unable to work he receives an annual pension of $203.25. Should he die from the accident the bureau pays $20 as burial expenses, and the wife and children, if the latter are less than 15 years of age, receive $153, and the widow receives a pension until she dies or remarries, and the children until they reach the age of 15.

A blacksmith earning $256 accidentally loses a finger. The diminution of his capacity to work is indemnified by a payment of 10 per cent of his wages and an annual pension of $17.

A farm hand injures his knee. He receives one hundred and five days' treatment in the hospital, which costs the rural accident bureau $38. His family is given $19, or one-seventh of the average annual wages. Upon leaving the hospital the man has lost 90 per cent of his capacity to work, and so receives an annual pension of $78. If he dies the accident bureau pays the burial expenses of $9 and pays annually to his family $65.

Disability and Old Age.—This insurance in the German Empire is obligatory from the sixteenth year, and embraces every workman earning over $482. It is optional for workmen whose annual earnings are more than $724. The resources for this insurance are furnished by the employer, the employed, and the State, the latter giving toward each pension a uniform subvention of $12 and paying the workman's dues during the time he is serving his military term. All remaining expenses are shared equally by the employer and the employe, who pay according to the five classes into which the Imperial Insurance Office has arranged the insured, viz: (1) Workmen gaining no more than $84 pay 3.3 cents per week; (2) a wage not greater than $133 pays 4.8 cents weekly; (3) a maximum wage of $205 pays 5.8 cents; (4) a maximum wage of $277 pays 7.24 cents, and (5) a wage between $277 and $482.50 pays 8.68 cents weekly. The amount paid by the workman is deposited in the bureau by the employer, who buys special stamps and affixes them to the employe's

receipt, after having deducted from his wages the amount due.

The minimum of a disability or infirmity pension, which is not allowed for less than two hundred weeks' work, is $28 for the first class, $31 for the second, $32.50 for the third, $34 for the fourth and $36 for the fifth class. After fifty years or two thousand weeks of work these pensions are increased to $44.75 for the first class, $65 for the second, $79.50 for the third, $94 for the fourth, and $108.50 for the fifth.

An old-age pension is paid to every insured workman of 70 years or over who has deposited not less than 1,200 weekly dues. The dues deposited for the employe by the State during military service are counted among these 1,200 as well as temporary interruptions. Old-age pensions of the first class amount to $26, second class $34, third class $41, fourth class $48, and fifth class $55.50.—Thornwell Haynes, U. S. Consul, Rouen, France.

THE WESTINGHOUSE DIRECT-CURRENT INTEGRATING WATTMETER.

INTEGRATING wattmeters for alternating-current service have been made by the Westinghouse Electric and Manufacturing Company since such instruments were first introduced, and the characteristics of the Westinghouse type have become very generally known. The announcement, therefore, that this company has developed a direct-current integrating wattmeter, which contains many of the special features found in the alternating-current type, and is constructed with the same regard to long-continued accuracy, strength, durability, and convenience in installation, will fix the position of the new meter in the first rank, and give a definite idea to meter users as to its value. Its design is the result of an exhaustive series of tests of each and every factor which affects its performance, and of the large experience gained in the manufacture of other meters.

In general appearance the new instrument resembles the Westinghouse alternating-current integrating wattmeters. The case is finished in black enamel, with letters in low relief, as illustrated in Fig. 1. The terminals enter at the sides, passing through the case, the line wires being connected on the right-hand side of the meter, and the load wires on the left, the upper wire line being the positive. To make connections, it is only necessary to bare the ends of the wires, to insert them in the bushings at the sides of the case, and to tighten the binding screws. The bushings form a close junction with the terminal blocks, and make the case as insect and moisture proof at this point as at all others.

By removing the cover, as shown in Fig. 2, all parts of the mechanism are exposed. The adjustments, which are wholly mechanical and do not depend upon variable resistance or similar arrangements, can then be easily made. To compensate for friction, the shunt coil shown at *A* in Fig. 2 is moved in or out, this coil being held in position by two screws which clamp against brackets as shown.

The speed of the disk is controlled by two permanent magnets, so mounted as to secure perfect alignment. Moving the magnets in from the edge of the disk increases the speed, and moving them out toward the edge decreases the speed, at any given load. Releasing the adjusting screws, one of which is shown at *B* in Fig. 2, permits the magnets to be moved as required.

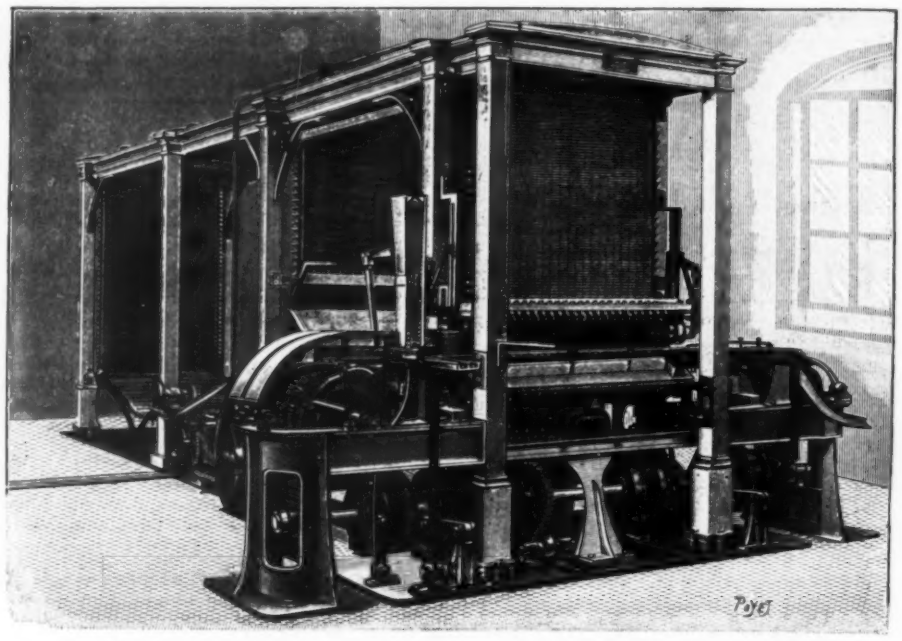
The lower bearing of the shaft is of the cup-and-ball type, the same as that used in Westinghouse integrating wattmeters for alternating current, which has thoroughly demonstrated its value in reducing wear and friction. The shaft terminates in a removable sleeve with a slightly cupped sapphire jewel, which rests upon a hardened steel ball 1/16 inch in diameter. This ball is supported by a second jewel, similarly cupped, which is set in the end of the adjusting screw, which forms the lower half of the bearing. The lower jewel is spring-mounted, a construction which effectually protects it against sudden jar. The steel balls and jewels undergo a special polishing process, and are rigidly inspected before using.

The very slight friction of a bearing of this form, which is much less than that of any heretofore devised, insures the meter remaining in calibration at light loads longer than is possible with a bearing of any other type; and this feature, combined with the reduced weight of the moving element, affords a longer period of active service for this meter than for others.

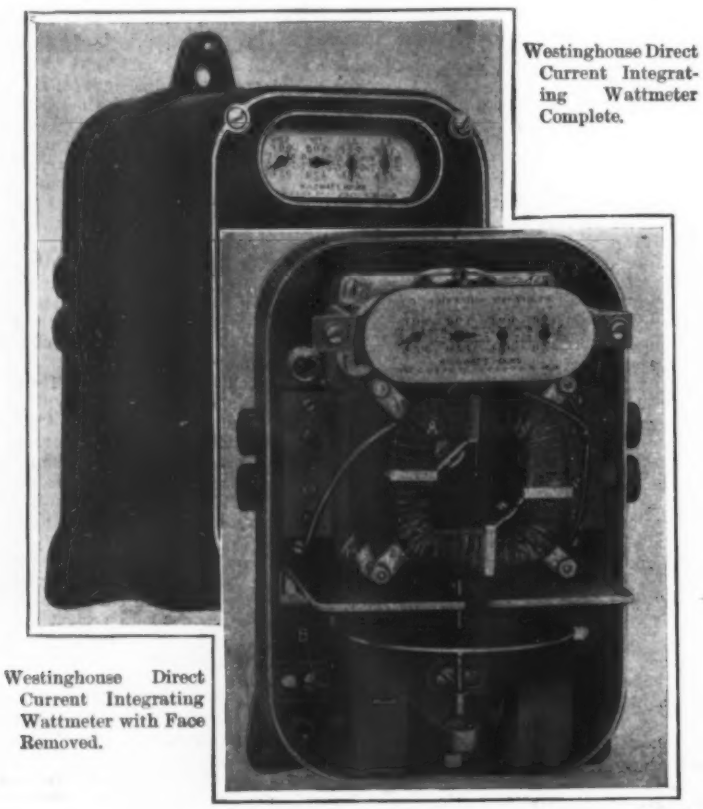
The commutator is an important part of all direct-current wattmeters, and requires the use of non-oxidizing metal, and a diameter small enough to minimize friction. Especial attention has been given to this feature, and it has been fully developed in every respect, the diameter being only 5/64 of an inch, which insures a reduction of friction to a minimum.

A perfect commutator is ineffective, however, without suitable brushes, so this feature has been made a subject of special study. Perfect contact with the least amount of friction must be maintained, and the material must be such that oxidization will not take place. The brushes in this motor are composed of a number of strands of wire of non-oxidizing material. This subdivision of the brush gives an excellent contact, as each strand is thereby made a separate brush, and the series of strands conform exactly to the surface of the commutator with less total tension, insuring ideal working conditions.

All features, both mechanical and electrical, are of the highest standard, and the new direct-current wattmeter is sure to receive a cordial welcome from central station managers.



NEW AUTOMATIC MATCH MACHINES AT AUBERVILLIERS, FRANCE.



Westinghouse Direct Current Integrating Wattmeter Complete.

Westinghouse Direct Current Integrating Wattmeter with Face Removed.

A NEW AUTOMATIC MATCH-MAKING MACHINE.

AN important mechanical progress in the manufacture of matches has recently been made at the state manufactory at Aubervilliers, near Paris, where there has been set in operation the remarkable machine, a specimen of which was shown at the exposition of 1900.

We shall not dwell here upon the old method of manufacturing matches nor the inconveniences attending it, such as necrosis or "phosphorism," which continued to be a genuine scourge until it was checked by doing away with the use of white phosphorus, by a better ventilation of the working rooms, and by greater watchfulness.

For the white phosphorus there was substituted the sesquisulphide of phosphorus, which is practically innocuous. Then the automatic machines were improved so as to protect the operatives against all harmful operations. Finally, in the near future, necrosis will exist only as a disagreeable remembrance. The automatic machine that has put an end to phosphorism is supplied at one end with splints of white-wood, sulphur, paraffine and a paste of sesqui-sulphide of phosphorus, and, at the other, with small wooden or paper boxes, which it fills with great regularity. The principal part that carries the matches during the entire manufacture consists of a steel plate 2 inches in width and about 40 in length, which is provided with five rows of equidistant apertures. Each of the rows comprises 110 apertures capable of furnishing either a box of 100 matches, or two boxes of 50 each. A few supplementary apertures of a number indicated by experience provide for "misses."

The apertures are circular and of a diameter sensibly equal to the side of the square formed by the section of a match. The result is that after the small splints of wood have entered the apertures, they remain fixed therein by a relatively strong pressure. The plates, collectively, are carried by an endless chain, the driving of which by ratchets assures a regular and continuous operation. In order to feed the plate, a female operative continually fills a receptacle with splints taken from feed-boxes. Under the influence of repeated vibrations, the splints fall into grooves formed in a horizontal cast-iron table, whence they are expelled at every stroke of the machine by a corresponding row of punches which direct them to what is called a "transporting carriage." This latter consists of a cast-iron table having a to-and-fro motion and in which are formed 110 grooves placed directly opposite those from which the splints are expelled. After the carriage has been supplied with splints, it advances horizontally toward a vertical press. During this motion a knife ascends in the rear of the grooves, and the splints can no longer recede. Since the width of the cast iron plate is less than the length of the splints, the latter lap over in front and are forced, when they meet with the apertures of the press, to enter and remain fixed therein when the carriage moves backward. But this forcible entrance necessitates a high pressure that might cause breakages through flexion, and so, to prevent such flexion, there is provided a horizontal piece of cast iron which grazes the top of the grooves. The splints carried along by the chain are now to become matches, and, for this reason, they in the first place have their free ends dipped into a bath of paraffine, which impregnates them, and then into one of sulphur. Next, by means of a roller coated with a pasty mixture, through its revolution in a tank filled with

the same, one end of the splints is provided with a "head" of inflammable material. The removal of the matches from the apertures of the press requires the penetration with extreme precision of 110 expelling punches into 110 apertures 2 millimeters in diameter; and these punches are scarcely 12 millimeters in length. In performing this operation, the punch-frame is provided with very weak springs that permit it to follow the motion of the plate just as would be done by the hand of an expert workman desiring to make the two pieces coincide. The operation is effected without shock.

The loose matches then fall by bunches of five into recesses, whence they are expelled by the action of pistons, which shove them into the boxes. These latter are introduced into the machine in piles by a female operative, and are opened and filled therein mechanically.

A machine making 45 strokes a minute produces in 10 hours' work 50,000 boxes of 50 matches, or fifteen million boxes a year.

All the manufacturing and boxing operations are, as may be seen, mechanical, and the human hand intervenes only for the feeding of the machine with raw materials. Two female operatives suffice for the running of one machine. In order to assume a perfect manufacture, a third operative is required for examining and classifying the boxes at their exit from the machine.

It is of interest to recall the fact that in the old and dangerous processes of manufacture, it was necessary for the same work to employ twenty male and female operatives, upon whose personal skill depended the result of the operations.—Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

RECENT GAS AND OIL ENGINE DEVELOPMENTS.*

By THOMAS HOLGATE, M.I.C.E.

MOST of the engines exhibited at Earl's Court were of the single-cylinder horizontal type; they showed that development is proceeding along the lines (*a*) of higher compression of the charge before ignition; (*b*) of employing electric ignition in lieu of tubular; (*c*) more convenient means of starting; (*d*) in large engines, of water cooling for the exhaust valves. These advances in recent years, combined with better governing, have brought about considerable reduction in the cost of gas for working, and increased satisfaction in the uniformity of power generation.

The Simms-Bosch igniter appeared upon the majority of the engines, and it is evident that the replacement of tube ignition which has very largely taken place on the Continent has now set in in this country. The embodiment of these several ideas in the "Stockport" engine, made by J. E. H. Andrew & Co., Ltd., may be regarded as almost typical of many of the well-known makers, whose machines it is impossible to describe further. The compression is 100 to 180 pounds per square inch, according to size of cylinder. Those of 125 B. H. P. and upward have water-cooled exhaust valves. The starting is done by means of a pump, and the ignition by electricity. The late starting of the latter is effected by hand, on trip gear provided.

The Westinghouse engine was represented by drawings and photographs of the various combinations of vertical cylinders that they make up to large powers. The starting is done by compressed air from a cylinder previously charged during the working of the engine. The governing is done by controlling the quantity of gas and air admitted per charge, while the ignition by electricity is expected to receive an early development by the adoption of Sir Oliver Lodge's new system.

The smallest engines using gas, within the grounds of Earl's Court, were the Lowne patent atmospheric engines. They are made in five sizes, the largest giving one-half horse-power, and the smallest one-fortieth of a horse-power; they are therefore suitable for light work such as a hot-air engine would usually perform. The power exerted is due to a reduction of pressure caused by cooling the products of combustion of gas or oil, when they come in contact with the walls of the water-jacketed cylinder. The utilization of vacuum was effected for part of the power in the Otto and Langen or flying piston engine, but in the "Lowne" the whole of the power is obtained from that source at a pressure of five to six pounds per square inch below atmosphere. A No. 2 size, having a cylinder of 2 inches diameter, a flywheel of 12 inches diameter, and of 26 inches by 17 inches by 17 inches height, width, and depth, respectively, and weighing 32 pounds, as made by Messrs. Hardy & Padmore, Ltd., has been tested and found to give, at 480 revolutions per minute, nearly one-tenth of a horse-power; but at 400 revolutions, a better working speed, the horse-power was 0.076. The consumption of London gas was 100 cubic feet per B. H. P.

A gas flame burns at the top of the vertical cylinder, and the piston, for about the first half of its stroke, draws the flame and its products into the cylinder through a valve which then closes. By the time the piston has completed its outstroke, the products N_2, H_2O, and CO_2 have been cooled sufficiently to create a negative pressure of five to six pounds per square inch, the condensation of the steam conducing to this result. The pressure of the atmosphere above that in the cylinder expels the products, and the valve is again opened and the cycle repeated. It is thus seen that the working parts are few—as befits a domestic motor—that there is no compression or explosion of a charge, and only one light is required, although as a precaution a small by-pass light is employed in case the larger one were sucked out by the moving piston. The starting is effected by turning round the flywheel by hand, after the gas has been lighted or the oil has been burning for five minutes.

The "Gothic" engine, made for gas or oil, is the invention of Mr. Melhuish, and is made by Messrs. Thomas Glover & Co., Limited, in sizes from 2 to 10 B. H. P. The distinctive feature is that an impulse is given at each complete revolution, or two strokes of the piston; and that this is obtained by the exhaustion of the burnt gases by means of an auxiliary or partial vacuum cylinder, in tandem with the working cylinder.

It has been proved that in using certain oil motors, an increased duty per gallon of oil can be effected by the admixture therewith of a small percentage of water, and this mingling is effected in the "Gothic" engine by the auxiliary piston, which first sucks up the oil from a receiver on the outstroke, and then on the instroke delivers waste gases and water vapor through a small tube in required proportion.

The drawing (Fig. 1) will enable the following description to be understood. Assuming the piston to be at its complete instroke and a charge compressed—in the case of oil, to 40 pounds, and of gas to 60 pounds per square inch—this is fired by a hot tube placed horizontally under the carbureter. The flame heating the igniting tube serves also to heat the oil in the carbureter *K*. The explosion expels the piston on its outward stroke, giving out power as shown by the indicator diagram. When it reaches the part *A* any pressure remaining passes out through the check valve *B* (shown in the cross-section), thus reducing the pressure in the cylinder *C* to that of the atmosphere. The continued outward movement then uncovers the exhaust port *D*. During the operation thus described the front end of the piston creates a partial vacuum in the condenser *E*. As soon, therefore, as the piston *F* uncovers the port *D*, the products of combustion remaining in *C* are induced into *E*, whence a part of them pass into an expansion cylinder, *G*. The new charge of air which now flows into the cylinder (to take the place of the waste gases) enters by the valve shown opening downward, which as hereinafter explained, is also under the control of the governor. On the return stroke, the products in the condenser *E* are displaced through the valve *H* into the exhaust pipe *I*. The lower part of the condenser is preferably covered to a depth of half an inch with water; and by the rapid expansion and the evaporation of the water therein by

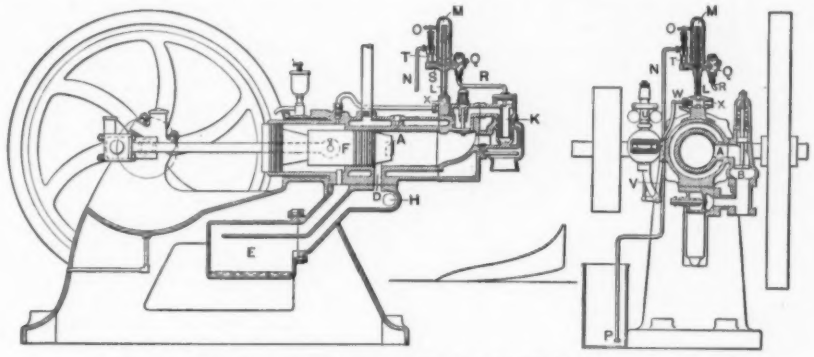


FIG. 1.—THE GOTHIC TWO-CYCLE STATIONARY ENGINE.

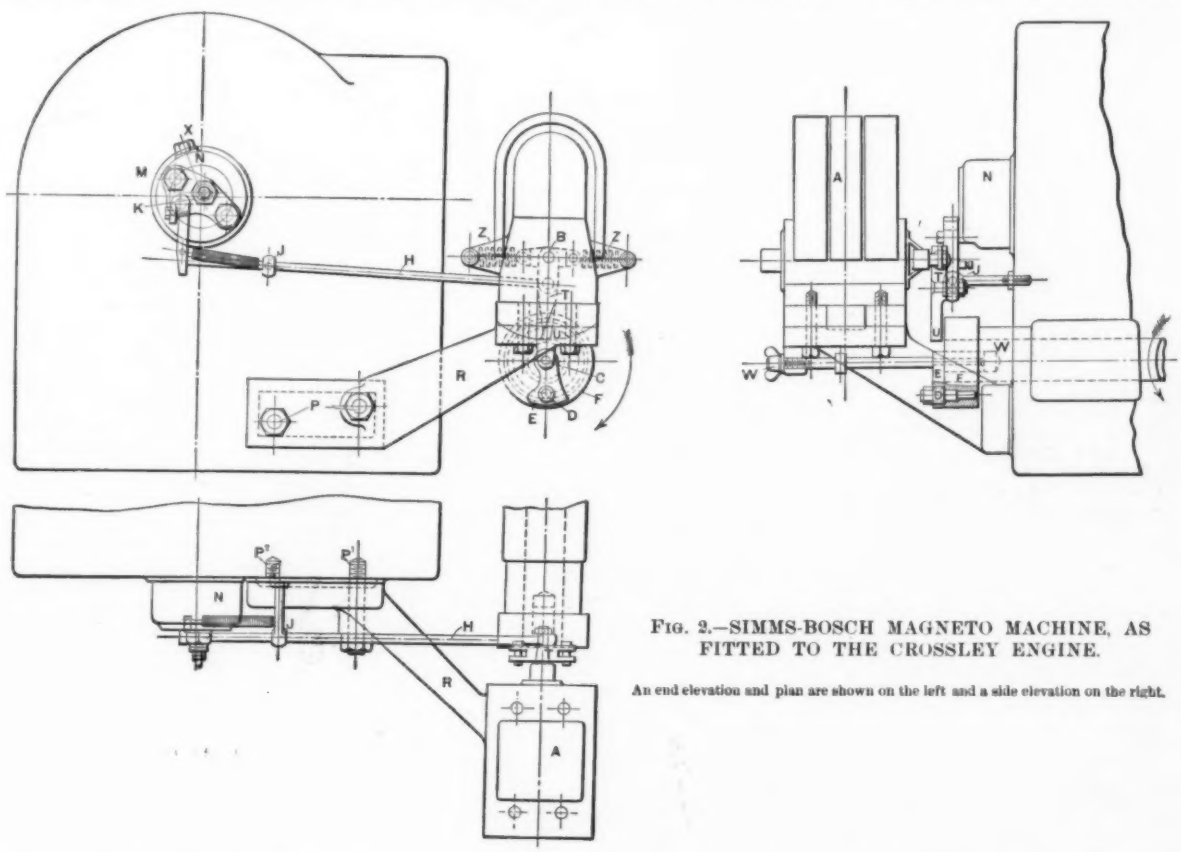


FIG. 2.—SIMMS-BOSCH MAGNETO MACHINE, AS FITTED TO THE CROSSLEY ENGINE.

An end elevation and plan are shown on the left and a side elevation on the right.

* Technics.

the products of combustion, the portion of these entering the cylinder *G* is comparatively cool. The vacuum created in this cylinder is used to lift the oil from the container *J* and deliver the same in definite quantities to the vaporizer *K*. This is done through the communication of the partial vacuum along the pipe *L* to the vessel *M*. The latter is connected by the pipe *N* and regulating cock *O* on one side, the lower end of the pipe *N* terminating in a non-return valve *P*. On the other side of the vessel *M* is a delivery valve *Q*, and a pipe *R* leading into the vaporizer *K*. Now, at every *outstroke* of the piston the partial vacuum lifts a quantity of oil (the amount being determined by the cock *O*) into the small cavity *S* of the vessel *M*, the oil being visible as it feeds through the glass *T*. On the *return stroke* the pressure exerted by the pump piston drives the oil out through the non-return valve into the vaporizer *K*. Some of the waste gases and the steam generated thereby in the condenser are then driven through the pipe *L* into the vessel *M*, and are condensed as water; after mixing they are driven with the oil into the vaporizer *K*. When this mixture enters the working cylinder with its proportion of air the effect of the water is to delay combustion. The governing is effected by the belt-driven centrifugal governor *U*, connected by a central spindle to the bell crank lever *V*, attached by a link *W* to a plunger *X*, that by its movement to and fro, opens and closes communication between the vessel *M* and pump cylinder *C*, thereby shutting out the action of the pump and stopping the supply of oil. Should the governor belt break, or should the governor from any cause stop, the plunger in this instance moves out, and by preventing the flow of oil stops the engine. A stepped catch *Y* holds the plunger at starting the engine, and when the normal speed is obtained, automatically falls and leaves the governor free to act to cut the oil out at too high a speed. The mode of governing just described is that delineated in Fig. 1; but in a later development it has been found an improvement to control the flow of combustible to the working cylinder by the governor open-

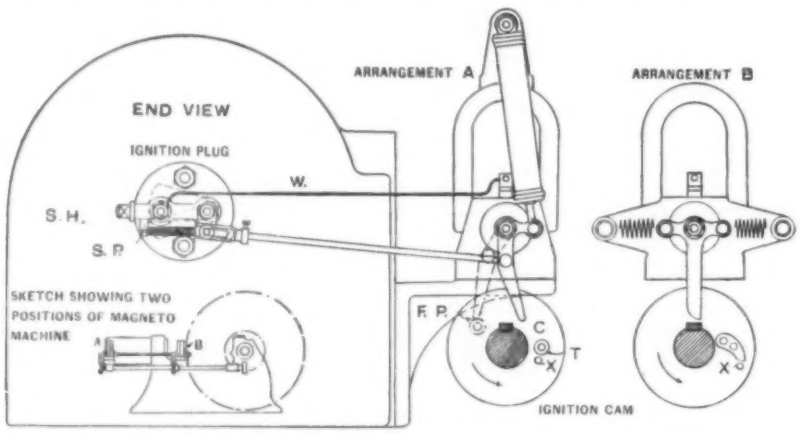


FIG. 3.—DIAGRAMMATIC REPRESENTATION OF TWO TYPES OF SIMMS-BOSCH MAGNETO; ALSO SHOWING TWO ALTERNATIVE POSITIONS FOR MAGNETO.

W, connecting wire. F. P., firing plug. S. P., sparking plug. S. H., sight hole. C, cam. T, trip roller. A and B, alternative positions for magneto. To retard spark, place plug in aperture X.

ing and closing the spring valve at the top side of the extremity of that cylinder.

The working cylinder is water jacketed. The auxiliary cylinder acts as guide by means of a second piston fitted with rings, to which the connecting rod is secured internally. These details and the lubrication arrangements are clearly shown in Fig. 1, which, representing an oil engine, is (when the carbureter is removed) also applicable to the gas engine.

Russian petroleum with a specific gravity of about 0.82, or low or high flash oil between 85 deg. to 150 deg., may be used, requiring half a pint per hour per B. H. P.; while 20 to 21 cubic feet of gas, having a calorific power equal to that of Manchester, is similarly required.

The engine is an embodiment of the idea long prevalent that a two-cycle engine would give a more uniform turning moment than the prevailing Beau de Rochas or four-cycle. In the various two-cycle designs that have previously been tried, the second cylinder has been under pressure: this new type is differentiated therefrom by the fact that the compression and explosion are both in the working cylinder, while the scavenging is done by the auxiliary cylinder acting under pressure below that of the atmosphere. As a consequence of the action of the last-named cylinder, there is an absence of the side shaft, skew gears, rocking levers, and cams that are usually required to effect the succession of four-cycle operations in one cylinder.

The engine of Messrs. Crossley Brothers, Limited, direct coupled to an electric generator made by the Lancashire Dynamo and Motor Company, Limited, runs at 250 revolutions per minute and gives a maximum power of 29½ effective horse. The continuous working load of the engine (S.E. type) is 27½, which, with town's gas of 600 British thermal units net heating value, requires 14½ cubic feet per hour per B.H.P. When gas of 150 British thermal units net heating value is used, the output of power is reduced 20 per cent, viz., to 22 B.H.P., and the consumption raised to 65 cubic feet per B.H.P. Engines of this size work with a compression of 95 pounds per square inch; but in larger sizes of recent design this is increased to 150 pounds. The heavy fly-wheel necessary to secure sufficient uniformity of speed for the working of electric glow lamps is fitted on a balanced crank shaft supported on an out-end bearing, and this crank shaft is coupled to the dynamo by a flexible Raffard coupling. The mode of joining the two disks is by projecting pegs, upon which flexible material, viz., cotton rope, is wound. After the pegs are thus interlaced with the rope, the latter is spliced to make it endless.

Continuous lubrication is provided for the crank bearing, and the oil may be saved and re-used for less important bearings if desired. A simple appliance for the collection of oil and prevention of loss by splashing consists of a strip of spring steel, placed in contact with the gun-metal, where the crank shaft is thickened up for passing through the fly-wheel. The horizontally-placed governor is driven by gearing direct from the crank shaft, and not from the half-speed valve-operating shaft. By this mode of driving, the variations of speed are reduced from 2¼ to 1¼ per cent, as between full load and no load. In larger engines this improved governor, acting on a hit-and-miss arrangement, is supplemented by an automatic cut-out gear which proportions the charge of air and gas at the higher loads, but employs the "hit-and-miss" for the lower ones. The heavy flywheel keeps the variation of speed at any part of a given revolution (known as the "cyclical variation") at 1¼ per cent, or a total variation of 2½ per cent. Where this is required to be reduced, as in running alternators in parallel, the addition of a second fly-wheel accomplishes it.

The ignition may be either with duplicate hot porcelain tube, when town's gas is used, or by electric spark with fuel gas. In the latter case, a Simms-Bosch electro-magneto machine *A*, having an oscillating sleeve *B*, is employed (see Fig. 2). The magneto consists of three permanent horse-shoe magnets, an armature having a primary and secondary winding for the high tension type, and one winding for the low tension, and a shield or sleeve. The magnets and pole pieces are secured to a gun-metal base plate, which is supported from the engine by the bracket *R*.* As the low-tension type has alone been used on stationary engines, we describe that only. A single wire connects the armature with the sparking box *N*, with contact breaker *K* and *L* to form the spark; this box *N* is fixed on the engine cylinder, and is fitted with a sight hole *X*. At this box the sparking may be examined when gas is absent, by pulling over and liberating lever *T*. The engine side shaft has a special cam *E* and trip gear *T*, to give a quick motion to the magneto oscillating sleeve *B*; and it is also provided with a late sparking cam *E*, for starting the engine without fear of its running the wrong way, which it would do if the ignition took place before the dead center of the crank had been passed. The gear acts as follows: The trip lever *T* is pulled over by a trip roller *D*, fixed on the side shaft cam *F*. At the correct moment the trip lever *T* is released; then, by means of the two springs *ZZ*, the lever flies back to its normal position at *U*, making the electric current, the trip lever *T* at the same time breaking contact in sparking box *N* by means of pusher rod *H*, and forming electric spark in box *N*, when the charge is ignited. The engine having started running, the late starting cam *E* is disengaged by a thumb-screw *W* under the magneto *A* (Fig. 2). The current generated by the magneto is conveyed by the single wire to the ignition plug, consisting of an insulated pin and a moving lever, which are separated mechanically by the engine, so as to cause the spark to pass, producing the ignition at the proper time. The sparking points *K* and *L* adjust themselves to any wear, and they can be readily freed from any water or oil that may be deposited on them, while the whole gear can be removed and replaced in a few minutes. As the magneto will give a spark at the slowest speed of rotation of the engine, no difficulty occurs in firing the combustible at the time of starting.

In the air supply tube is fitted a wing valve, actuated by a worm and wheel, which in turn are operated by a small hand wheel. This enables the volume of air to be approximately adjusted to the calorific power of the gas being used.

The Simms Manufacturing Company, Limited, exhibited petrol motors of the single, twin, and four cylinder types, each capable of being operated by gas. An essential part of these motors is the magneto ignition either by low tension already referred to for stationary engines, or of the high tension or arc light type primarily designed to take the place of accumulators and coils, and more especially of the same as applied to existing multi-cylinder motors on road cars. When the low tension is used for high-speed motors, the rotary armature and rotary sleeve are employed, the "make and break" being effected like that for the stationary engines, and shown in Fig. 11, page 351, vol. 1, Technics.

A 3½ B.H.P. single-cylinder four-cycle motor has a bore and stroke each of 82 millimeters, and as in the larger sizes, the inlet valve is mechanically operated. A float-feed carbureter is fitted, having an automatic mixture regulator, insuring a constant proportion of petrol vapor and air at all speeds. It is fitted with the high-tension ignition, and the advance sparking gear is contained inside and forms a part of the magneto machine. It is provided with a safety sparking gap inclosed from the atmosphere. The range of speed is from 300 to 3,000 revolutions per minute. The height, length, and width over all are 20¼, 11¼, and 6¼ inches respectively, and the weight, including the ignition and carbureter, is 65 pounds. A four-cylinder water-cooled motor, giving 20 B.H.P. at 1,200 revolutions, in running order, weighs 370 pounds, of which 68 pounds is in the fly-wheel. The height from top of compression cock to bottom of crank chamber is 22 inches, the width over frame attachments 16¾ inches, and length from end of crank shaft to back of fly-wheel 35 inches. The machine works at a compression of 70 pounds per square inch, and the diameter and stroke of pistons are 95 millimeters and 110 millimeters respectively. The weight per B.H.P., viz., 18½ pounds, is very small, and the advent of six-cylinder motors promises still further reduction, due to the absence of a fly-wheel made possible by the absolute uniformity of turning moment on the crank shaft.

Each gas-engine maker applies the magneto to his mechanism in a slightly different manner, and the principle of the same is embodied in Fig. 3, where the standard or suggested methods are delineated. This low tension magneto is made in three classes: (*a*) with oscillating sleeve, (*b*) with rotary armature, and (*c*) with rotary sleeve. In these three classes are modifications to suit (*a*) single, or (*b*) multiple cylinder motors, or (*c*) high-speed motors, and (*d*) slow-speed motors. The rotary sleeve type recently introduced includes the advantages of the oscillating sleeve and rotating armature; that is to say, it has a rotating movement of the sleeve and a fixed armature arranged in such a manner that the current does not pass through the bearings. The armature is adjustable, and allows of a variation of 120 deg. in the sparking position. With this machine four sparks are obtained every revolution, thus allowing it to be operated from the half-speed shaft of the engine. The oscillating sleeve is, however, more suitable for one or two-cylinder motor car engines, where only a limited space is available for the magneto drive, the oscillating machine being very easily connected up.

* For further description of the principal details of this machine, see SUPPLEMENT No. 1452.

CONTEMPORARY ELECTRICAL SCIENCE.*

FLUORESCENCE AND ABSORPTION.—J. B. Burke adds further observations on the change of absorption in uranium glass in the fluorescent state. He, as well as Nichols and Merritt, found that when uranium glass is excited to fluorescence it transmits light less readily than when quiescent. The author deals with Camichel's negative result, and attributes it to his having used a fluorescent glass to cut off the more refrangible rays. He maintains that the prevalent idea that the spectrum of fluorescent and phosphorescent bodies is continuous is erroneous, for whenever the luminosity was of sufficient brightness, the spectrum which, when the light was feeble, seemed continuous, was found distinctly to be made up of finer bands, while when the intensity was diminished the distinctly band-like spectrum was once more found to be dimmed and became continuous. Therefore if, by any means, the light of precisely the same period as the fluorescent light were sifted or removed from the spectrum of the light, transmitted through uranium glass, we should not expect to get any variations in the absorption corresponding to the changes in the body during the fluorescent state.—J. B. Burke, Royal Society, read March 30, 1905.

SYSTEM OF UNITS WITH TWO FUNDAMENTALS.—A. E. Haas sketches a system of units which eliminates mass and contains time only in connection with velocity. The system leads to simple and rational formulæ for the chief electric and magnetic quantities. The dimensions of mass are derived from Newton's law:

$$MLT^{-2} = MML^{-2},$$

which, if the gravitational constant is unity, gives $M = L^2T^{-2}$, or LV^2 if V is velocity. Quantity of electricity and quantity of magnetism are given the same dimensions as mass. Energy has then the formula LV^4, current strength is V^2, force is V^4 and power is V^5. Resistance is V^{-1} and resistivity LV^{-1}, while capacity is simply L^1. Potential, whether due to gravitational, electric or magnetic force, is simply V^2 and magnetic moment is V^2L. The mechanical units may be obtained by substituting in the usual formulæ LV^1 for T and LV^2 for M. No fractional indices can thus arise. The

* Compiled by E. E. Fournier d'Albe in the Electrician.

electric units above are all measured electrostatically, but if the velocity of light is taken as the unit of velocity the difference between the two electric systems disappears. One would suppose, however, that no rational system can be arrived at by making the dimensions of magnetic pole and electric quantity the same.—A. E. Haas, Physikalische Zeitschrift, April 1, 1905.

ELECTRICAL NOTES.

M. Chanuz, of Lyons, France, has published the results of his investigations during the year 1904. Water drawn from the Rhone for the supply of that city was examined every day during the year. The variation in the congelation point was not more than 0.01 deg. C., but the variations in the electrical conductibility were considerable, exhibiting a minimum in August and September, but an ascending scale from the month of October; the maximum was reached in March. The difference is explained by the fact that the melting of the snows in the latter portion of the summer furnished water but slightly charged with saline matter. The limits of conductibility correspond to those of a solution of 1.55 and 1.85 of sodium chloride in a liter of water.

It is probable that the actual temperature of the tantalum wire is not very much higher than that of the carbon filament. If the total radiation varies as the fourth power of the absolute temperature, and the radiation of any particular wave-length as the fifth power, it is clear that very little rise of temperature will increase the light efficiency enormously. A very slight difference in the melting point of a metal may thus make a very large difference in its efficiency for a given life. It is probable there are many metals which have not been tried hitherto, and we may yet find one which gives much better results even than tantalum. It rather looks, however, as if the physical constitution of solids is such that even the most refractory will not stand above a certain temperature, at which it gives about a candle per watt.

The extraction of mica which, twenty years ago, was trifling, now engages thousands of hands. From a chemical standpoint, the various species are silicates of alumina and of potash, but there are several kinds, in which soda replaces potash. The Faiun mica, according to the results of an analysis at the University of Berlin, includes the following constituents given in percentages: Alumina, 34.52; silica, 46.22; potash, 8.22; iron oxide, 6.04; oxide of manganese and magnesia, 2.11; fluorhydric acid, 1.09; water, 0.98; other substances, 0.82.

Mica presents different colorations according to the country of its origin. That containing potash is translucent or presents greenish, yellowish, reddish, and gray tints; that containing magnesia has darker colors; that containing large proportions of iron has a color varying from gray to black.

The new Blondel arc lamp, which is attracting some attention, is characterized by the use of carbons containing magnesium and fluorine salts. One of these lamps gives 1,200 candle-power, using 5 amperes and 46 volts, which figures 0.2 watt per candle-power. The carbons have a relatively short duration, this being but eight or nine hours. According to Prof. Wedding, a Blondel lamp having carbons of 9 millimeters diameter (0.036 inch) takes a current of 2.99 amperes and 57.4 volts, corresponding to 171.5 watts. It gives a light of 1,339 candle-power, making 0.128 watt per candle. A larger carbon of 11 millimeters gives 2,210 candle-power, at 0.109 watt per candle. A yellowish light is obtained from the lamp. It has the disadvantage of going out rather frequently, from the fact that a melted matter or slag is formed on the positive carbon.

A new electric sugar process has been brought out by Count Schwerin de Wildenhoff, which allows of obtaining a colorless syrup free from albuminoid matter. It can be submitted at once to a crystallization. As the negative electrode he uses a permeable layer of carbon which is not of great thickness. To neutralize the acids which are produced at the anode, he places under the latter a layer of an oxide of alkaline earth metal such as calcium or magnesium. The best results are obtained with magnesia. The apparatus is formed of a square and open receptacle, built of a non-conducting material. At the bottom is an opening for emptying the products. Upon supports is placed the negative electrode, which is formed of a layer of carbon placed between filtering cloth. The whole is supported by a metal grating connected to the negative pole of the circuit. The electrode thus formed is fixed by means of an insulating frame. The space which is left free in the receptacle is filled with a layer of the sugar-producing material, such as beet scrapings, up to a certain height, and it is covered by a filtering cloth. They add water containing finely powdered hydrated magnesia, and the positive electrode is placed in the liquid in a horizontal position. Water can be added from time to time by a piping. When the current is thrown on, electrolysis of the decomposable salts is produced, and at the same time an electric endosmose of the undecomposed soluble parts. The albuminoid matters are retained at the negative pole upon the layer of carbon. The sugar solution is thus freed from albumen and it retains the alkalis which are set free at the negative electrode. An alkaline syrup which is colorless and very pure comes off from the apparatus. During the operation the water which is utilized at the positive pole is replaced from time to time. With finely divided beet material they obtain a syrup having a mean purity of 97 to 98 per cent, and an alkaline value of 0.15. These tests have only been made on a small scale as yet, and the commercial value of the process will not be established until the cost of production is known.

ENGINEERING NOTES.

The new Hamburg-American liner "Amerika," which is the heaviest ship in the world, and will be installed upon the New York and Hamburg service, was recently launched at the shipyard of Messrs. Harland & Wolff at Belfast. The dimensions of the vessel are 670 feet in length, beam 74 feet, depth 52 feet, while her height to the boat deck is 77½ feet; tonnage, 22,500. She will have a speed of 20 knots. The "Amerika" will have accommodation for 3,000 passengers, and a crew of 530. She will make her maiden trip in September.

The 12-pounder gun is being slowly discarded in the armament of British battleships except for field and boat purposes. For defense against torpedo-craft attack, the 12-pounder is being superseded by the new semi-automatic 3-pounder, which is a more effective weapon, and is even superior to the 3-pounder gun at present in vogue. The upper works of the ships are to be thickly studded with these guns. In night work these arms will be assisted in their duties by the 6-inch weapon. Efforts are also being made to communicate the range to the guns not inclosed in casemates by suspended figures lighted by electricity and so placed as to be visible to all the gun-layers and sight-setters of the light quick-firing guns.

The British Admiralty are carrying out a series of trials with the turbine-propelled cruiser "Amethyst," and the cruiser "Topaze," fitted with reciprocating engines. The object of these tests is not to ascertain the comparative speeds or coal consumption of the two systems of propulsion, but the following factors: (1) Starting from rest, the two ships lying abeam of each other, to determine the relative rates of "gathering way." (2) From a speed of 15 knots to full speed astern. (3) From a speed of 10 knots to full speed astern. The results of these novel tests will be awaited with great interest by marine engineers, as great doubt has existed regarding the capability and efficiency of the turbines in this connection as compared with the reciprocating engines.

The Condition of St. Mark's.—The scaffolding necessary for the restoration and strengthening of St. Mark's at Venice is now completed, and the engineers, Signori Manfredi and Marangoni, are busy directing the work. The condition of the cathedral, now that it has been possible to examine it closely, is found to be graver than appeared from the report of the two engineers, the weakest point being the Paradise and Apocalypse vaults. Though every care will be taken to maintain the vaults as they originally were, some part of them will have to be demolished and rebuilt; but it is impossible to say now in what proportion, as it is only in the process of demolition that the weaknesses will become fully apparent. The examination of the interior structure of the St. Alipio corner, which was excluded from the restorations made about the middle of the nineteenth century, has revealed an even graver state of things. The foundations of this corner have since then continued to sink, and the corner now stands independently from the rest with only one iron bar, put there in 1780, to keep it and the main body together. The corner will have to be demolished and reconstructed in order to strengthen the foundations. It will probably be necessary to remove and replace some of the ancient mosaics.—Building News.

An interesting bridge-building contract is being carried out over the River Barrow, Ireland, the feature of which is the extent to which compressed air has been requisitioned in connection with the construction of the foundations. The bridge is of thirteen spans, of which the longest, a large swing opening span, is of 140 feet, and is to be operated by electric motors for the purposes of opening and closing the bridge within three minutes. With regard to the foundations, the engineers found it necessary to sink the cylinders to carry the piers to what is believed to be the greatest depth yet reached in connection with bridge foundation work. When the work was commenced, it was anticipated that at a depth of 50 feet the material would be sufficiently stable to carry the structure, but as the work progressed it was found necessary to proceed another 50 feet or more to reach a solid foundation. The deepest pier is 117 feet below high-water level, a second 114 feet, a third 113 feet, while four others range from 109 feet to 103 feet. At the 117-foot depth the pressure amounted to 50 pounds per square inch; and as this was realized to be beyond the limit of human endurance, the engineers, Sir Benjamin Baker, Sir William Arrol, and Mr. A. S. Biggart, had to adopt means whereby the pressure under which the men were working was limited. Those engineers employed the same successful principle as used by them in building the foundations of the Forth Bridge. Ejectors were employed for action against leaks in the working chamber. By this means it was possible to use an air pressure less than that produced by the head of water. Consequently, work was carried on at a pressure of about 40 pounds per square inch until the excavation reached a depth to within a few feet of that which was requisite. At this point, however, a strata of water-bearing material was encountered overlying the rock foundation, and the air pressure had to be raised, notwithstanding the fact that a great volume of water was still discharged by the air ejector. In the deepest cylinder the final air pressure was 43 pounds per square inch above atmospheric pressure, but in the majority of the others the work was completed with an air pressure of over 40 pounds per square inch. These high pressures, however, produced little effect upon the workers, and the undertaking was completed with success.

SCIENCE NOTES.

Suppression of Sound in Dwellings.—Herr Nussbaum discusses in the Zeitschrift für Architectur und Ingenieurwesen the methods at the disposal of architects for suppressing or deadening sound in habitations, and sums up the most available as follows: Against noise from without, thick walls and double windows; against noise proceeding from the same story, thick partitions, double doors, and hangings; against noise from an upper story, cork waste, wood sawdust and layers of kieselguhr, plaster, and tow under the floors.

An important communication on the action on the human system of the poison of the Indian cobra is published in a recent issue of the Philosophical Transactions of the Royal Society, based on investigations undertaken at the instance of the Secretary of State for India by Surgeon-Captain Elliot. While earlier investigators ascribed death from cobra-venom in most cases to paralysis of the respiratory centers, the author concludes that the main cause is a rise of blood-pressure caused by the contraction of the minute arteries, which thus afford a barrier to the circulation.

Oxyacetylenic Blowpipe.—Since MM. Fouché and Picard originated the oxy-acetylenic blowpipe in 1901, experiment and practice have led to improvements, and there are now three systems employed in France. Each has a characteristic construction, differentiated mostly by the means used for avoiding the return of the flame. In the first, porous substances are employed; in the second, wire gauze; in the third, small tubes of great length. The consumption of these different blowpipes amounts to 100 to 150 liters of oxygen per 100 liters of acetylene. The temperature realized with each is more than three thousand degrees. At least three hundred or four hundred establishments make use of one or other of these instruments.

Vanadium Steel.—New researches by M. Guillet have led to results demonstrating distinctly that steels are extremely sensitive to thermic treatment, and that vanadium steels are heterogeneous. These are his conclusions: 1. Vanadium steels, annealed at 900 deg. C. and slowly cooled, are not more fragile than ordinary steels of the same percentage in carbon; and with the same resistance, they are less fragile. 2. These steels seem particularly sensitive to thermic and mechanical treatments. 3. Steels of high percentage in vanadium, of which all the carbon is in the state of carbide, are absolutely heterogeneous. This is due probably to the carbide of vanadium, which, pre-existing in the molten mass, tends to rise to the surface. It may be affirmed that the only vanadium steels of interest are those containing less than 0.7 per cent of vanadium.

A few days ago, at the annual meeting in London of the Association of the Chambers of Commerce of the United Kingdom, a representative of the Liverpool Chamber moved the following resolution, which was agreed to: "That as another step in the direction of the adoption by this country of a decimal system of weights, and in supplement to the 50 pounds weight recently authorized by the Board of Trade to facilitate the weighing of cotton, corn, tobacco, etc., by centals and pounds, this association respectfully asks the Board of Trade to authorize forthwith weights of 20 pounds, 10 pounds, and 5 pounds, also, as aliquot parts of the cental. In making this request the traders specially concerned wish to acknowledge gratefully the concession already made them in the matter of the 50 pounds weight, which has fully answered the expectations in the saving of time, labor, and expense." Report has already been made of the special Order in Council, announced through the Board of Trade, sanctioning the use of a weight of 50 pounds. The British government also provided standard 50-pound weights for use and reference at the various official weigh houses. The commercial community now desire official sanction to the use of 20 pounds, 10 pounds, and 5 pounds as further aliquot parts of the cental. There can be little doubt that the government will in course of time grant the request. It will be noted that the cental (100 pounds) is the standard or unit weight of the aliquot parts of which official sanction is desired. It is a curious fact that what is known as a "hundredweight" in nearly all commercial transactions in the United Kingdom is really 112 pounds, and a "half-hundred" is 56 pounds; and this, too, in spite of the fact that the cental (or true hundredweight) has been officially recognized in the corn trade for a long while, and it has recently been adopted by the cotton trade. Last year the tobacco trade of Liverpool induced the Dock Board (which officially weighs imported tobacco in the warehouse) to state the total weight in pounds in addition to the weight in British hundreds (112 pounds), halves (56 pounds), and quarters (28 pounds), and odd remaining pounds. The ancient hundredweight was 100 pounds. It was raised to 108 pounds by Edward I. in order to make it equivalent to the hundredweight of the pounds of some other countries (such as the French and the Netherlands troy pounds); and Edward III. raised the hundredweight to 112 pounds for the purpose of division into 8 "stones" of 14 pounds each. In this way the English ton of 20 hundredweight (formerly 2,200 pounds) was raised to 2,240 pounds. The latter weight is now universally used in this country for a ton; in certain foreign transactions (particularly American), however, calculations are made upon the ton of 2,000 pounds, which is called the "short" ton, while the ton of 2,240 pounds is called the "long" ton.—James Boyle, U. S. Consul, Liverpool, Eng.

TRADE NOTES AND RECIPES.

To Restore the Qualities of Brittle Caoutchouc.—Objects of India rubber that have become brittle may be placed in a solution of 1 part of ammonia in 2 parts of water. In half an hour the rubber will resume its pliability and elasticity.—Gummi Zeitung.

Disinfectant.—The following is an excellent liquid for disinfecting sick rooms, care being taken to ventilate frequently: Guiac, 10 parts; eucalyptol, 8 parts; phenol, 6 parts; menthol, 4 parts; thymol, 2 parts; oil of cloves, 1 part; alcohol of 90 per cent, 170 parts.—Chemiker Zeitung.

Economical Lubricant.—This is prepared simply and at little cost by the following formula: Clean paraffin oil, 500 parts; oleum, 100 parts; colza oil, 50 parts; spent lime, 25 parts. To vary the consistency, it is sufficient to vary the proportion of lime. It may be colored as desired.—Corps Gras Industriels.

A white metal particularly adapted to the levers and keys of typewriting machines, is composed of 57 parts of copper, 20 parts of nickel, the same quantity of zinc and 3 parts of aluminium. It remains white like silver, is worked without difficulty, and receives polish perfectly.—Practicien.

Universal Cement.—Take gum arabic, 100 grammes; starch, 75 grammes; white sugar, 21 grammes; camphor, 4 grammes. Dissolve the gum arabic in a little water; also, dissolve the starch in a little water. Mix and add the sugar and camphor. Boil on the water bath until a paste is formed which, on coating, will thicken.—Farben Zeitung.

Cleaning of Painted Doors, Walls, etc.—The following receipt is designed for painted objects that are much soiled. Simmer gently on the fire, stirring constantly, 30 grammes of pulverized borax, and 450 grammes of brown soap of good quality cut in small pieces, in 3 liters of water. The liquid is applied by means of flannel and rinsed off at once with pure water.—Le Praticien.

Consumption of Calcium Carbide.—There are now 66 establishments producing calcium carbide: 16 in Germany and Switzerland; 8 in Austria; 14 in France; 5 in Italy; 2 in Spain; 1 in England; 8 in Sweden and Norway; 1 in the Argentine Confederation, and 11 in the United States and Canada. They produce 88,000 tons per annum, and their capacity for production can be doubled or trebled.

Railway Lighting with Acetylene in Sweden.—The first experiment in lighting railway cars in Sweden by means of dissolved acetylene was made on the line from Stockholm to Saltsjoaden, about thirty kilometers in length. The results are deemed so satisfactory that this method of lighting has been extended to three other lines proceeding from Stockholm. It has also been introduced on the railway from Christiania to Solvesberg and that from Gothenburg to Vestergotlands.

The influence of the Russo-Japanese war on the faience manufacture of Sarraguemines, which employs three thousand operatives, and exports largely to Russia, has been rumored to be so great as to necessitate the discharge of a large number of its employes. The rumor is now authoritatively denied by the Lothinger Zeitung, which asserts that the loss of trade with Russia has been offset by orders from Egypt, the East Indies, and Africa; these sections of the globe usually furnish altogether its largest markets, and their present forecast removes all probability of a reduction in the operative force.

The Demand for Cements in Siam.—Cement is an important importation of Siam. But as the competition of producing countries is great, the profits are small. The lowest prices often prevail, and in this respect the Italian product has an advantage. The Austrian cement is of better quality, but dearer, but cannot compete with the Italian. The Danish cement has the advantage of direct dispatch from Copenhagen. The Austro-Hungarian consul at Bangkok reports the importations as 25,972 tons, of the value 238,635 ticals, in 1901, and 36,718 tons, of the value of 300,976 ticals, in 1902. A tical is worth about 60 cents. Of the amount, 16,000 tons came from Denmark, 9,167 from England, 6,761 from Germany, 2,802 from Italy, 1,915 from Singapore, and 76 tons from other countries.

An International Syndicate of European Glass Manufacturers is to be the result of strikes and other industrial disturbances. For about ten years there have been two separate associations, each of which is possessed of great influence, the Verein Deutscher Spiegelglasfabriken in Germany, and the Comptoir General de Vente, under the auspices of the St. Gobain Company, in France. Each has a similar organization, including a central body composed of delegates of the affiliated companies, which receives orders from purchasers and distributes them according to fixed regulations. Without being officially connected, they have worked in harmony, and now are to be united, grouping with the manufacturers of other countries. The process of consolidation has meanwhile been going on between separate establishments, which will now become a part of the international group. The Revue des Valeurs Regionales states that the Belgian glass producers, weary of continual strikes, have emigrated to France; the works at Albert having been incorporated with those at Aniche, and the works at Jurnet with the Renard establishment at Fresnes. It is said that the proprietors of the glass works generally in all the European countries, except those of England, have given their adhesion to the plan of combination, or trust, as it would be denominated in this country.

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